AMPEX

1802852-02

CHANGE NOTICE

This change is to be collated into Manual Number 1802852, dated 1 November 1975. Superseded pages are to be destroyed.

FR-3010 Operator/System Manual

ISSUED: 1 NOVEMBER 1975

CHANGED: 15 FEBRUARY 1976

000661A

Note: Asterisk denotes pages affected by latest change.

LIST OF EFFECTIVE PAGES

This manual consists of 133 pages, comprised as follows:

Issue -02

CHANGE PACKAGE
15 FEBRUARY 1976
AMPEX MANUAL 1802852

Attached is the 15 February 1976 change package for FR-3000 Tape Transport Manual 1802852, issued 1 November 1975. This package changes the manual to 1802852-02.

The attached pages either take the place of equivalent pages in the original manual, or are additions. Where pages are replaced by equivalent new ones, remove and destroy the old pages and install the new ones in their places. Where completely new pages are being added, place them as indicated by their page numbers, and as noted below.

In the front matter:

Remove pages v through xii. Insert new pages v through xxiv.

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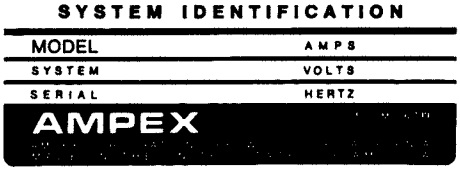
The term cycles, and the abbreviations cps, kc, and Mc will be noted variously on the nameplate, placarding, and drawings. All narrative within this manual, however, will express frequencies in Hertz, employing the abbreviations Hz (Hertz), kHz (kilohertz), MHz (megahertz), and GHz (Gigahertz).



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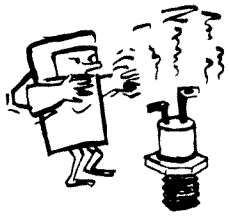
Because personnel working with electronic equipment are exposed to the hazard of high voltage, it is imperative that all safety regulations be consistently observed, and that each individual has a clear understanding of basic First Aid methods.

The following typical hazards must be avoided at all times:

1 Do not attempt adjustment of unprotected circuit controls, or lead dress while the power is ON.

2 Do not change heavily loaded or overheated components without due precaution to avoid burns.

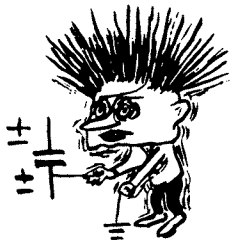


3 Do not assume that no dangerous voltage is present when the power is OFF. Charged capacitors may retain dangerous voltages for long periods, and should be discharged through a suitable resistor before any circuit points are touched.

4 At all times avoid placing any parts of the body in series between ground and circuit points, whether or not power is ON.

5 Do not assume that solid-state circuits and semiconductor cases carry only low voltages.

6 Be fully trained don't take chances.



7 Use power line isolation transformer.

For their own protection, and the protection of others, all electronic personnel should become thoroughly familiar with the approved First Aid treatment of burns and shock. There are three principal degrees of burns, recognizable as follows:

1. A first degree burn reddens the skin.
2. A second degree burn blisters the skin.
3. A third degree burn chars the flesh and frequently places the victim in a state of shock accompanied by respiratory paralysis.

Respiratory paralysis in the victim can cause death within seconds, by suffocation. For this reason it is imperative that the approved method of artificial respiration be initiated immediately and continued until the victim's breathing is normal.

A muscular spasm or unconsciousness may render the victim unable to free himself of the electric power. If this is the case, turn the power OFF immediately.

WARNING

DO NOT TOUCH HIM, OR YOU MAY SHARE HIS PREDICAMENT.

If the power cannot be turned OFF immediately, very carefully loop a dry rope, article of clothing, length of strong cloth, or a rolled-up newspaper around the victim and pull him free of the power. Carefully avoid touching him or his clothing.

The moment he is clear of the power, place him in a reclining position, cover him with a blanket (or newspapers) to keep him warm, and begin artificial respiration. At the first opportunity, enlist help in the summoning of a doctor. If a doctor cannot be summoned, transport the victim to the doctor, infirmary, or hospital. Be sure that the victim is kept well covered and warm while awaiting professional aid and treatment.

GOOD PRACTICES

In maintaining the tape recorder covered in this manual please keep in mind the following standard good practices:

1. When inserting or removing printed wiring assemblies, cable connectors, or fuses, always turn off the power to the affected portion of the equipment.

2. If replacing metal-oxide-semiconductor (mos) devices, follow standard practices to avoid introducing static charges onto their terminals.

WIRE IDENTIFICATION CODING

Identification of all insulated hookup wires used in a permanent application and harness wires shall be differentiated by (1) color coded insulation and/or by (2) printed numerical numbers representing the RETMA color code. Both methods are interchangeable substitutions throughout the assemblies.

1. COLOR CODING - Color coding shall be accomplished by use of solid colored insulation and/or helical striping on all white insulation in accordance with EIA STANDARD GEN-104.

2. NUMERICAL CODING - Number coding shall be printed numbers on all white insulation representing the applicable RETMA color code number, i.e., O-BLACK, 1-BROWN, 98-WT/GRY, etc.

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GLOSSARY OF TERMS AND ABBREVIATIONS

Following is a brief glossary of terms and abbreviations which are special to instrumentation tape recording or to the FR-3000 series recorder/reproducers.

Note that in this manual, abbreviations are capitalized as they would be if the words were spelled out. Because of this, the same abbreviation may appear capitalized differently in different places. Abbreviations are not punctuated except:

a. Where they spell whole words (l-e-d, not led, for light-emitting diode).

b. In plurals made by adding "s," an apostrophe is used (pwa's, not pwas)

c. Nontechnical abbreviations that are customarily punctuated (e.g., i.e., etc.)

CAPSTAN
A rotational element of a tape transport that impels the tape along its intended path. The tape is usually coupled to the capstan (a shaft, roller, or puck) by friction, sometimes assisted by pressure from a roller or rollers (pinch-rollers).

CONTROL TRACK
A tape track (see "track") used for a signal which is employed in controlling the capstan speed during reproducing (see "tape sync"). Also used to describe the recording on the control track, or the signal as played back.

EOT
End-of-tape. Refers to either end of the tape, and usually refers not to the extreme physical end of the tape, but to a point at which an automatic stop takes place to prevent the tape from completely unwinding from the reel -- the end of the usable portion of the tape.

FAST
Usually the fastest speed at which a tape transport will move tape, a wind or rewind speed. Often not under synchronous capstan control. Also, an operating mode in which the tape is moved at the fast speed.

FLUTTER
Instantaneous tape-speed errors having frequencies of variation between 0.5 Hz and 10 kHz. (For instrumentation, the term "flutter" generally includes the lower-frequency errors sometimes called "wow.")

FORWARD
The direction of tape motion so designated for a tape transport. On a recorder/reproducer, usually that direction of motion in which a point on the tape passes the record head(s), then the reproduce head(s). On a vertically-mounted, coplanar-reel transport such as the FR-3000, usually means tape motion from the top reel to the bottom reel. Also, an operating mode in which the tape is moved forward.

HEAD
The electromagnetic transducer which converts electrical energy into magnetic fields for recording; or magnetic fields into electrical energy for reproducing, using magnetic tape. For instrumentation purposes the record and reproduce heads are usually separate transducers of significant difference in design.

HEAD ASSEMBLY

An assembly that usually includes all the record or all the reproduce heads for a tape machine. The heads are usually grouped in stacks (see "headstack," below), with one or two stacks per assembly. The stacks are mounted on a precision baseplate, often along with precision guides or other critical components. The headstacks and guides are precision aligned on the baseplate at the factory and if they are removed, moved, or loosened, they must be realigned at the factory.

For standard analog instrumentation recording there are two stacks of record heads on a record head assembly. All odd-numbered heads are in the first stack reached by the tape when it is moving forward, all the even numbered heads are in the other stack. The headstack geometry is such that the tracks made on the tape by the record heads are "interleaved" (odd-even-odd-even) and evenly spaced. The reproduce headstack reads the tracks in the same geometric arrangement. For pcm (pulse-code modulation, or digital) recording/reproducing, all the record or all the reproduce heads, both odd and even, are often in the same stack, so that there are only two stacks, one record, one reproduce, in a complete recorder/reproducer.

HEADSTACK

A set of heads, usually all record or all reproduce "stacked" into a permanent assembly with the magnetic gaps very accurately aligned. It is not possible to disassemble a headstack without destroying it, and, if it is part of a precision head assembly (see above), it must not be removed from or loosened on the assembly.

IRIG

Inter-Range Instrumentation Group. The association of Government organizations concerned with missile-range telemetry and other instrumentation functions. Groups within the IRIG publish documents which define instrumentation standards that determine many practices in instrumentation, including instrumentation magnetic tape recording. Document 106, "Telemetry Standards," and Document 118, "Test Methods for Telemetry Systems and Subsystems," as well as other IRIG documents, may be obtained from: Secretariat, Range Commanders Council, White Sands Missile Range, New Mexico 88002.

MDA

Motor-drive amplifier. An electronics circuit that controls drive current to a motor.

POST-AIR

Term applied to a -12V power line on the load side of a transistor switch which is controlled by power-sensing logic, following a vacuum operated (air) switch.

PRE-AIR

Term applied to a -12V power line on the load side of a vacuum operated (air) switch but before it is controlled by power-sensing logic.

PUCK

The wheel-like component that mounts on the end of the capstan shaft and is the part of the capstan servo that moves the tape. A polymer coating around its circumference helps give the puck positive control of the tape.

PWA

Printed-wiring assembly. A fully assembled circuit board with components installed.

PWB

Printed-wiring board. A circuit board before mounting of components.

RECORD

(Verb and adjective. The accent is on the second syllable.) That operating mode of a recorder or recorder/reproducer in which a recording is made. Requires record signal electronics as well as a tape transport. The legend RECORD, or equivalent, often appears on a control pushbutton of the transport, regardless of electronics capability.

REVERSE

That direction of tape motion which is opposite to forward (see "forward," above). Also, an operating mode in which the tape is moved in reverse.

SCAN

A tape speed higher than the highest standard record/reproduce tape speed. The tape is under synchronous capstan control, and is moved rapidly for scanning to locate a desired portion of a recording.

SEARCH

A mode of operation in which the tape transport is controlled by external equipment in order to search out locations on the tape through the use of an address track such as a time-code track.

SEQUENTIAL

A mode of operation in which two (or more) tape machines are interconnected to provide continuous recording over a longer period than a single (or lesser number of) machine(s) could accommodate. Control is arranged so that when the tape on a machine which is recording nears the end (see "eot"), the machine generates a signal which automatically starts another recorder. After a period of overlapped (redundant) recording, the first machine stops and the other carries on the recording.

SHUTTLE

A mode of operation in which the transport automatically shuttles back and forth between two preselected points on a reel of tape for repetitive playback of a desired portion of a recording. (Requires the use of an optional footage counter and shuttle assembly.)

SPEED LINE

An electrical line (conductor or bus) which is activated when a particular tape speed is selected or in effect.

SPOKING

A defect of tape packing produced by excessive tape tension. The pack buckles so as to produce a polygon shape and visual effect of "spokes" radiating from the reel hub to the "corners" of the polygonal pack.

STOP/READY

A transport operating mode or state in which tape is not being moved, but the transport is ready to move it, and only the actuation of the pushbutton for an active mode is required to initiate tape motion.

SYNC

Abbreviation for synchronization or synchronism. Used to refer to the state of capstan operation in which the capstan tachometer signal or the control track signal is at the same frequency as the capstan servo reference signal, and phase-differences are being sensed by the capstan servo phase comparator to control capstan speed. (See Section 5 of the tape transport manual, Ampex 1802854, for detailed descriptions of capstan servo functions.)

TACH SYNC

That mode of capstan operation in which a tachometer signal from within the capstan assembly is used for comparison with the reference signal to produce synchronization.

TAPE PACK

The roll of tape on a reel, or hub. Builds up radially as tape is wound onto the reel (hub).

TAPE PACKING

Reference to the quality of the layering of tape into a pack. On a transport which is correctly adjusted and is therefore packing tape well, the pack is very smooth to the eye and touch, without spoking patterns or slippage.

TAPE STACK

Synonym for tape pack. Has particular reference to the radial measurement (thickness) of the pack as regards setting of end-of-tape (eot) sensing.

TAPE TRACK

A longitudinal area along the tape on which signals of one data channel are recorded or from which they are reproduced. The width, spacing, and relative location of tape tracks is determined by head or headstack geometry. For instrumentation usage, these geometries are usually ones defined by the IRIG. Once defined, tape tracks are often regarded as existing whether or not they happen to have recordings on them. Once defined, the track identities remain the same regardless of what electronics channel they may be associated with, through normally, track 1 is recorded and reproduced through electronics channel 1, etc.

GENERAL

The FR-3010 Instrumentation Recorder/Reproducer is a versatile laboratory tape transport which may be combined with various types of signal electronics. As a result of this versatility, separate manuals have been written for the:

a. FR-3000 Transport Maintenance (Ampex Part No. 1802854). This manual covers the overall and detailed description of the FR-3000 tape transport and its subassemblies. Additionally, it contains the procedures for all phases of field maintenance with the exception of preventive (routine) maintenance. Preventive maintenance is to be found in the Operator/System manual.

b. FR-3010 Signal Electronics (Ampex Part No. 1802855). This manual provides overall and detailed description of the FR-3010 signal electronics. It does not contain any maintenance procedures, since under normal circumstances maintenance and adjustment of the signal electronics requires the use of a tape transport. For this reason, operation and maintenance procedures are incorporated in the FR-3010 Operator/System manual.

c. FR-3010 Operator/System (Ampex Part No. 1802852). This manual covers the operation and field maintenance of an Ampex FR-3010 magnetic recorder/reproducer system. It includes the routine maintenance for the tape transport as well as the preventive maintenance, performance checks, adjustment procedures, troubleshooting, etc., for the FR-3010 signal electronics.

d. Accessory manuals. In order to provide a convenient means of storing individual writeups on the various accessory items for the FR-3010 recorder/reproducer, an FR-3000 series Accessories manual binder including front matter and dividers (Ampex Part No. 1802902) is provided with the recorder/reproducer system. The writeups for some of the individual accessories may be ordered under the following Ampex part numbers:

1. Footage Counter, Shuttle with Digital Limit Switch, 1802940
2. Footage Counter, Shuttle with Pushbutton Switch, 1802941
3. Voice Log Kit, All Tape Width, 1802942
4. Voice Log Kit, A or B track, 1" Tape Only, 1802943
5. FM Calibrate Card, FR-3010, 1802944
6. Remote Control Unit, 1802946
7. Servo Control Track PWA, with one cable and one control track jumper pwa, 1802947
8. Rack Dolly Assembly, 1802948

In the manuals listed above, shortened terms "FR-3010", "recorder/reproducer", and "recorder" are used interchangeably in place of "magnetic tape recorder/reproducer system".

INTRODUCTION TO THE MANUAL

THIS MANAUL

This manual provides overall descriptions of the FR-3010 recorder/reproducer, plus procedures for all phases of operation of the recorder/reproducer, plus system maintenance, including preventive (routine) maintenance.

Most of the manual is printed on 11 x 17 inch foldout pages. These oversize pages are used in order to make the maximum amount of related material visible at one time. (The pages are folded to 8-1/2 x 11 inches to make the manual fit into standard bookshelves, etc.)

The numbering system used for pages, figures, and tables in this manual is the standard one in which each such number consists of two segments separated by a hyphen. The first segment identifies the section of the manual. The second segment indicates the particular item of its type. (E.g., "Figure 7-2" means Section 7, Figure 2.)

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EQUIPMENT IDENTIFICATION

SECTION 1

EQUIPMENT IDENTIFICATION

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GENERAL

The FR3010 tape recorder/reproducer may be divided into two major assemblies:

a. FR3000 Tape Transport

b. FR3010 Signal Electronics

FR3000 TAPE TRANSPORT

The description, theory of operation, schematics, assembly drawings, parts lists, adjustment and maintenance procedures for the FR3000 Transport are covered in the FR3000 Transport Maintenance manual, 1802854.

FR3010 SIGNAL ELECTRONICS

The description, theory of operation, schematics, assembly drawings and parts lists for the FR3010 Signal Electronics are covered in the FR3010 Signal Electronics manual, 1802855. It is not possible to adjust or maintain the signal electronics without the use of a tape transport. As a result, the adjustment and maintenance procedures are to be found in this manual, the FR3010 Operator's manual, 1802852, which is concerned with both the signal electronics and transport assemblies.

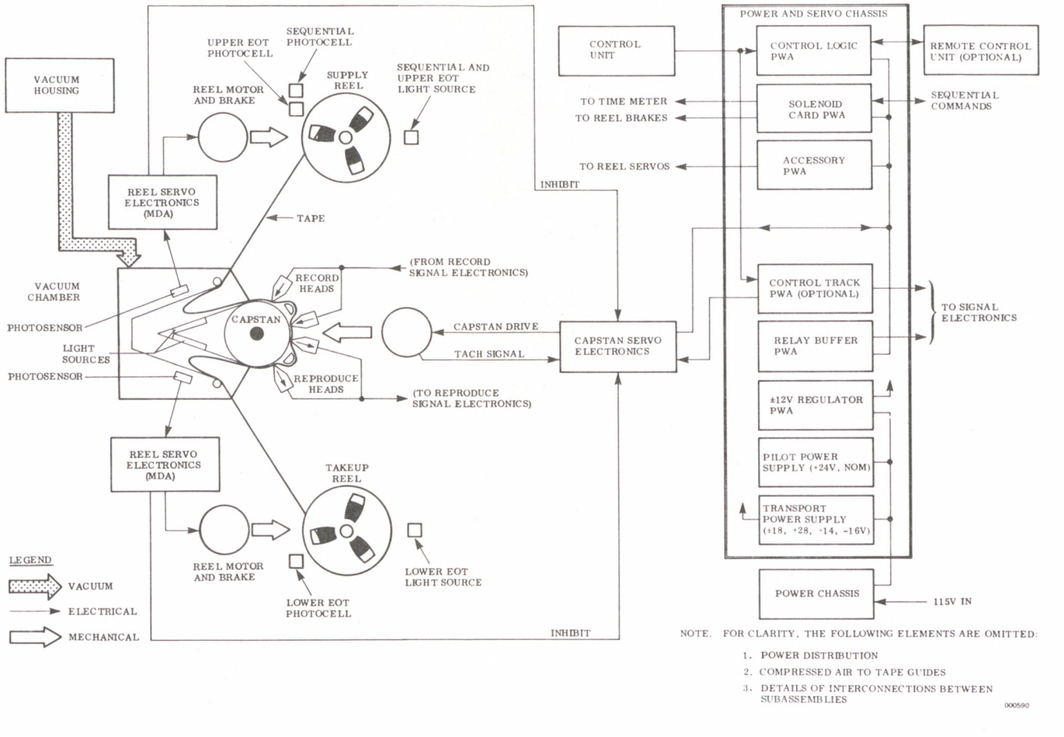

Figure 1-1. FR3000 Tape Transport Section Block Diagram

TAPE TRANSPORT SECTION

Reference FR3000 Tape Transport Section Block Diagram, Figure 1-1 and Figures 1-2 through 1-7, the FR3000 Series Tape Transport Assembly is a precision transport for 1/2 or 1 inch wide magnetic tape. It includes a rack cabinet assembly which accepts appropriate signal electronics subsystems to make up a laboratory-quality instrumentation tape recorder/reproducer.

The FR3000 moves magnetic tape between two reels under capstan control past the magnetic record and reproduce heads for recording and reproducing multiple tracks of information on tape. Both the capstan and reels are under servo control for precision tape movement. The reel sizes may be from 8 to 16 inches and the number of tracks (dependent upon tape width) from 7 to 28.

Tape speeds are available in two ranges:

a. High range - 7 speeds from 1 7/8 to 120 ips standard.

b. Low range - 7 speeds from 15/16 to 60 ips optional.

The tape may be moved at any of the above speeds in the forward or reverse direction (forward direction is from upper to lower reel). When a footage counter (optional) is installed, a shuttle mode is available. This allows automatic tape cycling between two preset points. Additionally, provision is made for sequential operation of two recorders. In this mode a recorder which is nearing the end of tape automatically starts the second recorder so that there is no interruption of recorded data. In addition, this automatically provides for switching facilities to the second recorder if there is a tape breakage or power failure in the first.

Another feature of the FR3000 system provides for tape search whereby the recorder can be made to search out an address on a control track (time-code track) at high speed and to initiate reproduction of data from that point.

The FR3000 may be controlled locally or from a remote location. It is mounted into a standard 19 inch rack and hinged at the righthand edge so that the tape handling mechanism can swing out for operator access. Components within the cabinet, such as the power and servo chassis, may be slid forward for easy access to their components.

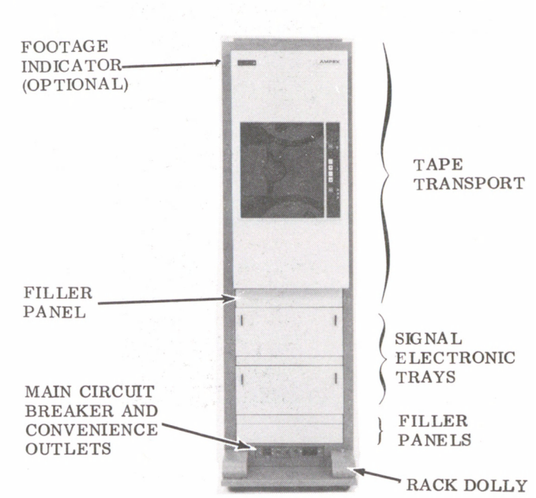

Figure 1-2. FR-3010 Recorder/Reproducer-Front View-Cover Doors Closed

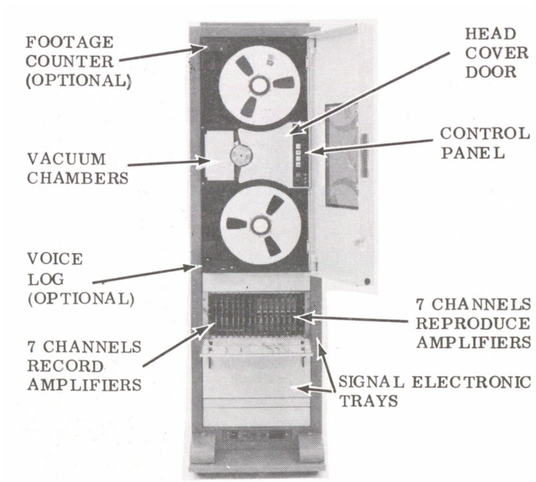

Figure 1-3. FR3010 Recorder/Reproducer - Front View - Cover Doors Open

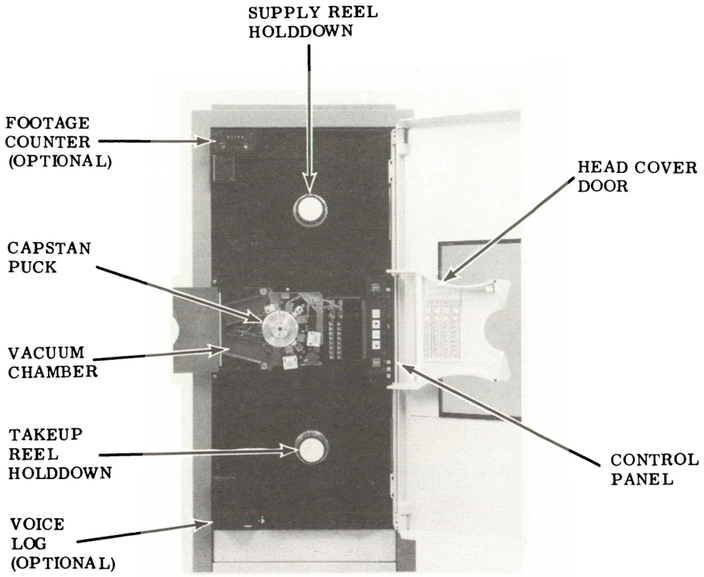

Figure 1-4. FR3010 Transport Section - Front View

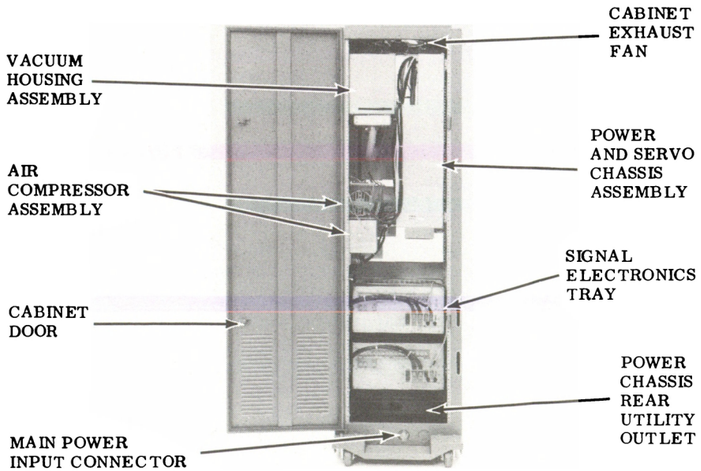

Figure 1-5. FR3000 Recorder/Reproducer - Rear View - Cabinet Door Open

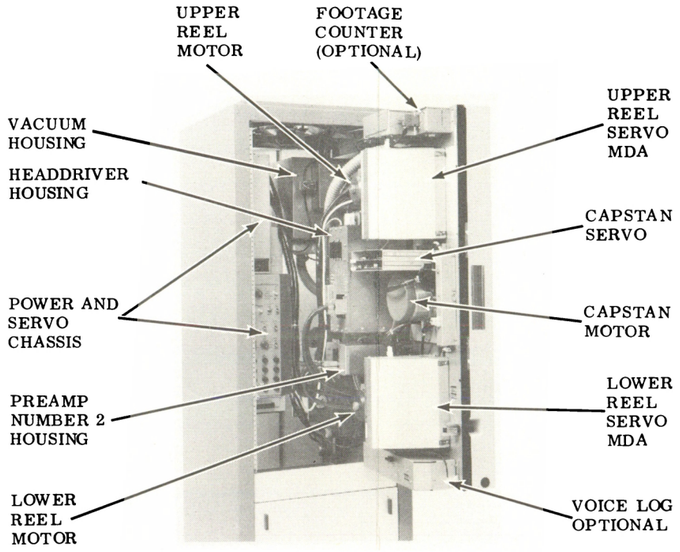

Figure 1-6. FR3010 Transport - Interior Assemblies

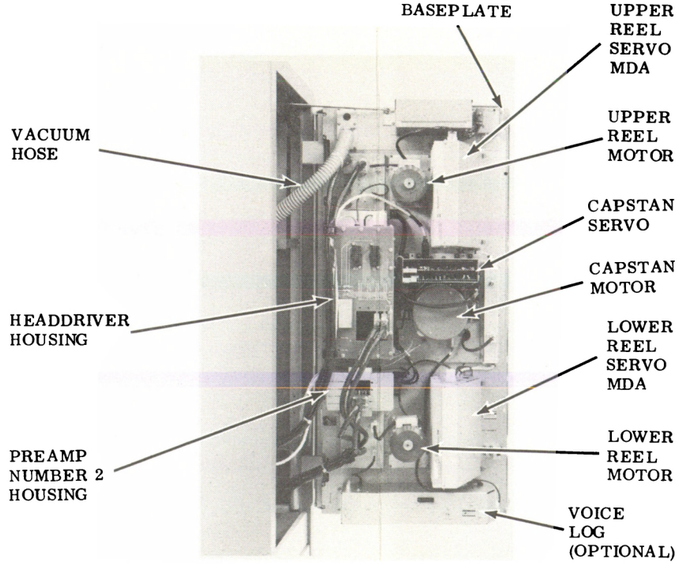

Figure 1-7. FR3010 Transport Baseplate - Rear View

EQUIPMENT IDENTIFICATION

SIGNAL ELECTRONICS SECTION

GENERAL

The signal electronics shown in Block Diagram Figure 1-8 may be essentially divided into four sections:

a. The data signal record and reproduce amplifiers which are mounted in the signal electronics trays. The trays are located directly beneath the transport assembly. See Figures 1-9 and 1-10.

b. The master bias oscillator and headdrivers which mount into the headdriver housing. The headdriver housing is mounted to the rear of the tape transport baseplate. See Figures 1-11 and 1-12

c. The preamplifier No. 2's which are mounted in the preamplifier No. 2 housing that is, in turn, mounted to the transport baseplate directly beneath the headdriver housing. See Figure 1-11.

d. The preamplifier No. 1's which mount in the preamplifier No. 1 housings (one for the odd and one for the even channels). The preamplifier No. 1 housings are mounted on the head baseplate of the reproduce head assembly. See Figures 1-13 and 1-14.

Power supplies for the above housings and their contents are located as follows:

a. Signal electronics - at the rear of the signal electronics tray.

b. Bias oscillator and headdriver - in the headdriver housing.

c. Preamplifier No. 2's - in the headdriver housing.

d. Preamplifier No. 1's - in the headdriver housing.

The types of signal electronics that are available for the FR3010 recorder/reproducer are:

a. Intermediate Band, 1.5 Wideband, and 2.0 Wideband Direct.

b. Intermediate Band, Wideband Group I, and Wideband Group II FM.

c. High density PCM.

The signal electronics trays can hold 7 record and 7 reproduce signal electronics. Two trays are required for a 14-channel record and reproduce system and four trays are required for a 28-channel record reproduce system. The signal electronics trays slide out of the transport rack cabinet for easy access to top edge adjustments and power supplies. Normal signal electronics adjustments are available at the front of the electronics tray by dropping the tray cover. See Figures 1-9 and 1-10.

Each of the headdriver pwa's contain eight channels. They slide into the headdriver housing from the front of the transport. Their adjustments and test points are front accessible. See Figures 1-11 and 1-12.

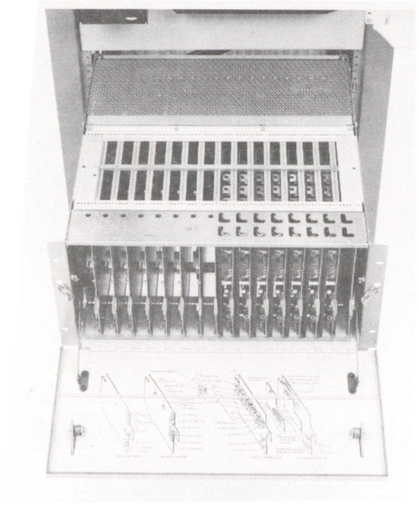

Figure 1-9. Signal Electronics Tray - Extended Position

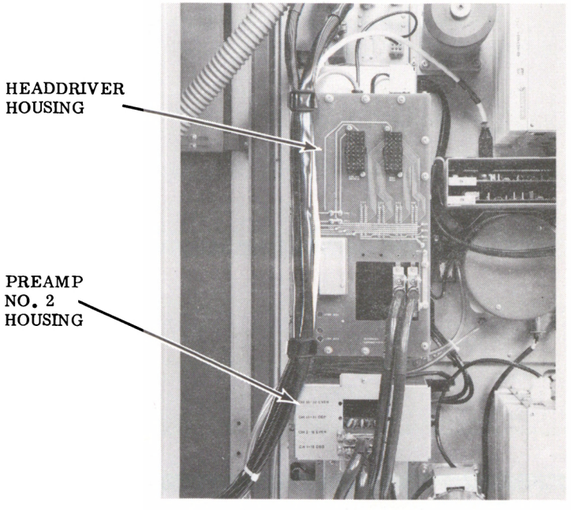

Figure 1-11. Headdriver and Preamplifier No. 2 Housings

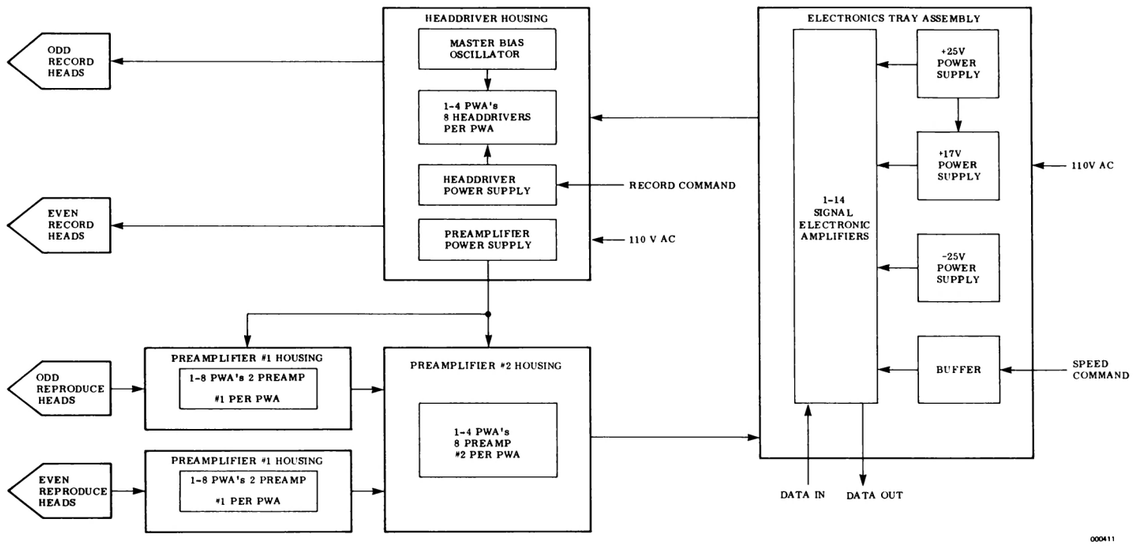

Figure 1-8. Signal Electronics Block Diagram

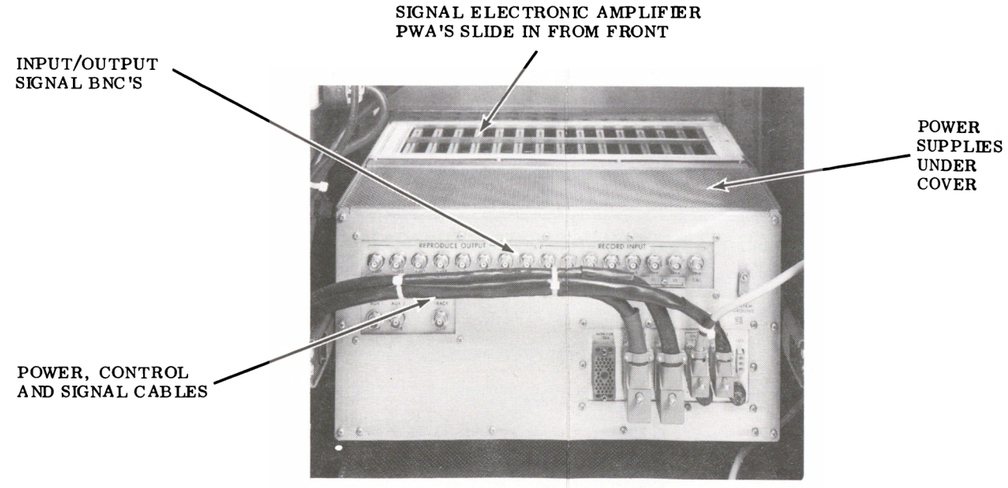

Figure 1-10. Signal Electronics Tray - Rear View

Each of the preamplifier No. 2 pwa's contains eight channels of electronics. Two preamplifier cards are required for 7 or 14-channel systems and four cards are required for a 28-channel system. There are no adjustments on the preamplifier No. 2 pwa's. See Figure 1-11.

There are two preamplifier No. 1's on each preamplifier No. 1 pwa. Up to eight pwa's may be inserted into each preamplifier No. 1 housing. A 7-channel system will require 2 preamplifier pwa's in each of the odd and even housings. A 14-channel system will require 4 preamplifier pwa's per housing and a 28-channel system will require 8 preamplifier pwa's. See Figure 1-13.

The record and reproduce head assemblies are mounted on their own baseplates. The record head assembly contains the odd and even headstacks and the halfmoon (tape) guide. The reproduce head assembly contains the odd and even reproduce headstacks, the halfmoon (tape) guide, and the preamplifier No. 1 odd and even housings. The entire record or reproduce head assembly may be slid away from the capstan area for cleaning or degaussing purposes.

When a voice log accessory is fitted, the voice log head mounts on the precision surface of the upper vacuum chamber. This head is a combination record and reproduce head. See Figure 1-12.

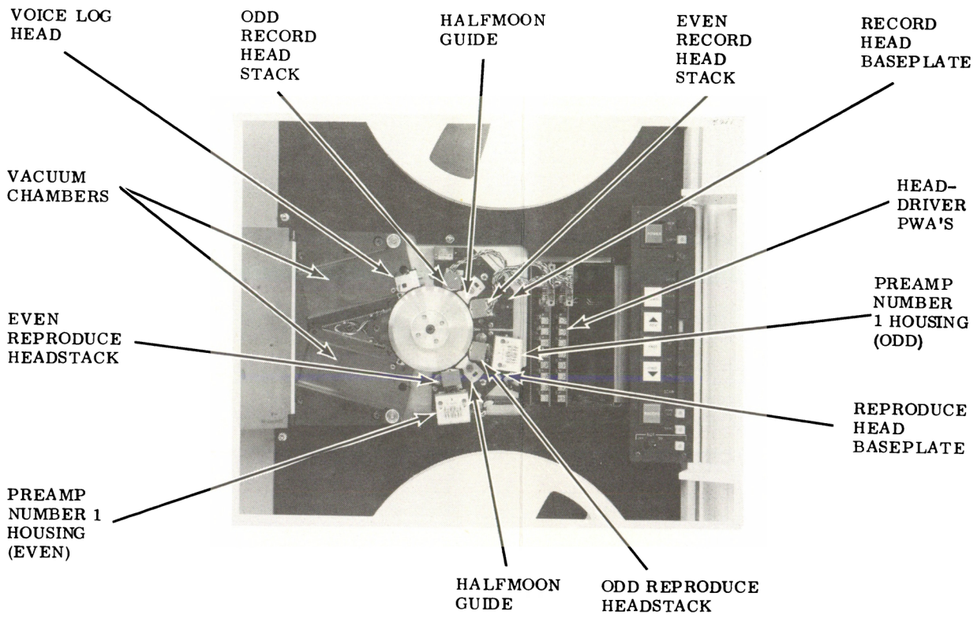

Figure 1-12. FR-3010 Head/Capstan Area

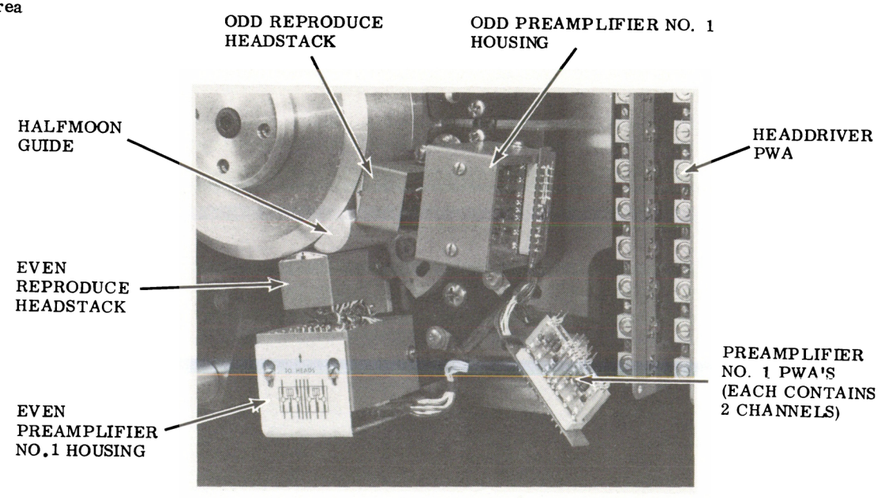

Figure 1-13. FR-3010 Preamplifier No.1 Housing

SECTION 2
SYSTEM INSTALLATION

SECTION 2

SYSTEM INSTALLATION

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SECTION 2
SYSTEM INSTALLATION

UNPACKING REQUIREMENTS

Ampex recorder/reproducers are prepared for shipment using various packing and packaging methods. The method selected for a given shipment depends on the mode of transportation, destination and contractual requirements.

WARNING

RACK-MOUNTED RECORDER/REPRODUCERS WITH TAPE TRANSPORTS INSTALLED HIGH IN THE RACK ARE VERY TOP-HEAVY. TO PREVENT INJURY TO PERSONNEL, OR DAMAGE TO THE EQUIPMENT, EXERCISE EXTREME CARE DURING UNPACKING AND HANDLING. AVOID TIPPING RACKS, AND DO NOT EXTEND THE TRANSPORT OR OTHER ASSEMBLIES UNTIL THE RACK IS BOLTED DOWN OR SECURED TO AN APPROVED DOLLY.

Magnetic tape recorder/reproducers are precision instruments, and adequate care must be employed during unpacking and handling to ensure proper operation of the equipment and to prevent equipment damage.

After unpacking make sure that all protective padding, blocks and tie downs used inside the equipment rack for shipment are removed. Inspect the equipment carefully for shipping damage, and if any is found, notify the shipping carrier and the local Ampex representative.

SITING

The FR3000 series magnetic tape recorder/reproducers can be installed in any location that provides a surface that is level, firm, free of vibration, and where ambient temperature and humidity fluctuations are kept as small as possible. In addition the environmental atmosphere should not contain corrosive fumes such as those found near storage batteries. Further the magnetic tape recorder/reproducers and magnetic tape should not be located in areas containing strong magnetic fields. These can cause deterioration or erasure of data (particularly high frequencies) on magnetic tape, and magnetization of the head assemblies and tape guides on the tape recorder itself.

For maintenance and operating purposes it is necessary that a minimum clear aisle space of 3 feet in front and 3 feet in back of the equipment is provided. See Figure 2-1 for the rack cabinet dimensions. A free flow of air through the rack must be maintained to prevent components from overheating.

The distribution of the weight of the units of the recorder/reproducer in the rack cabinet permits the operator to open an electronic tray or swing the tape transport out from the cabinet when the equipment is on a rack dolly. However, note the warning that follows:

WARNING

TO PREVENT INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT, NEVER EXTEND ALL BAYS, TAPE TRANSPORT, AND POWER AND SERVO UNIT AT THE SAME TIME UNLESS THE RACK CABINET IS BOLTED TO THE FLOOR.

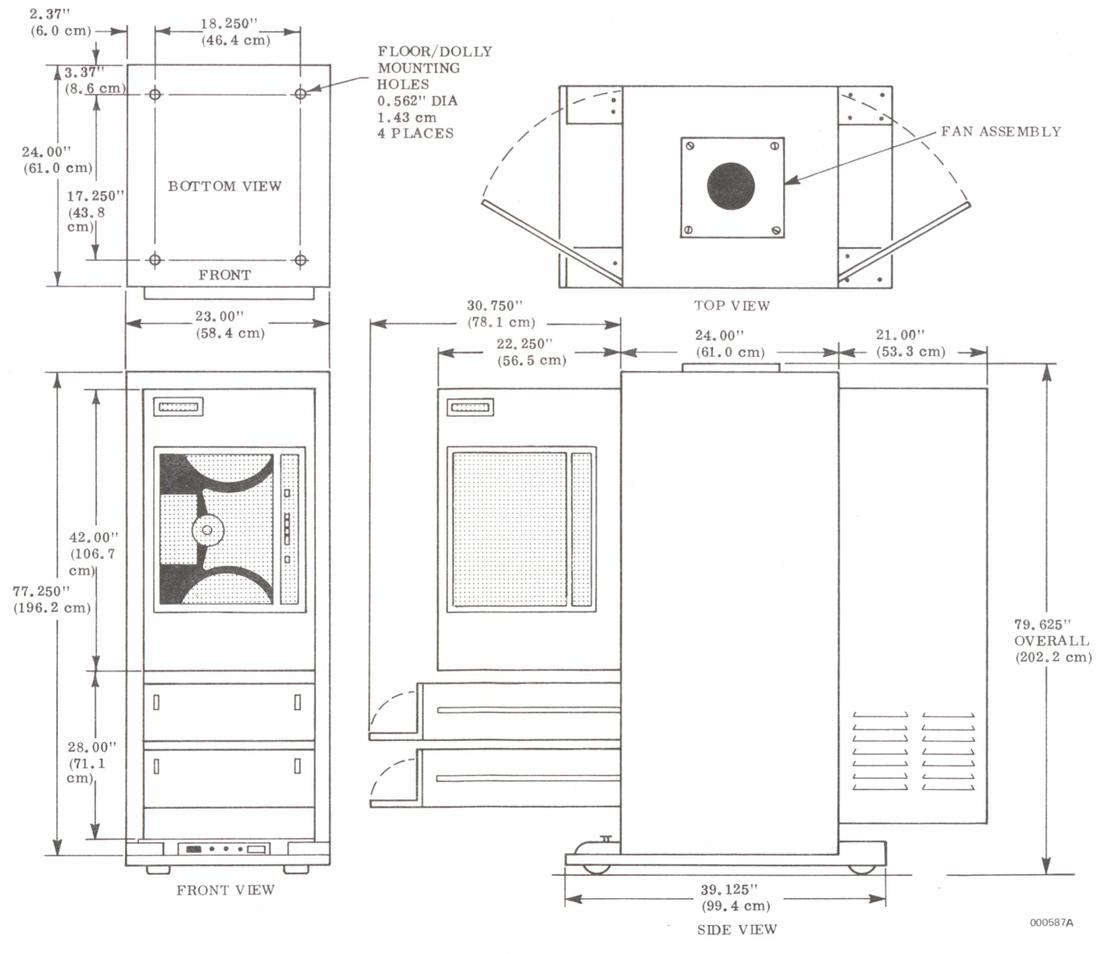

Figure 2-1. Rack Cabinet Dimensions

CABLE CONNECTIONS

SYSTEM CONNECTIONS

System cabling within the rack cabinet is usually installed at the factory. Should it become necessary to disconnect or remove any cables, cabling connections are shown in Figures 2-2 and 2-3A, B and C. Signal connections are made at the connectors at the rear of the signal electronics tray(s).

PRIME POWER CONNECTION

The primary power source, 105-125 volts, 47 - 63 Hz, is fed into a receptacle located on the rear panel at the bottom of the rack cabinet. A captive cable applies the primary voltage to the power panel, located on the recessed panel at the lower front of the rack cabinet.

A line filter assembly, Ampex 1802939 is available as an optional item for the FR3000 series recorder/reproducers. This filter assembly would normally be located on the rear insert panel at the bottom of the rack cabinet. An optional 220V to 110V step down transformer is also available (International Transfer Mounting Kit, Ampex 1802950).

SEQUENTIAL OPERATION CONNECTION

A sequential cable is available (Ampex 1802203) if sequential operation of two recorders is desired. The cable is connected between the SEQUENTIAL receptacles, J3, on the inner test panels, and the sequential switches (S6) are set to ON.

REMOTE CONTROL OPERATION CONNECTION

Operation of the FR3000 series recorder/reproducers from a remote location requires the use of remote control cable, Ampex 1802204. Connection for remote operation is made at the REMOTE receptacle, J7, on the inner test panel.

CONTROL TRACK OPERATION CONNECTION

A control track signal may be recorded and reproduced on any channel of the FR3000 series recorder/reproducers. To record the control track signal onto the tape, install pwa P107 (Ampex part number 1802905) in the power and servo unit, connect a jumper cable Ampex part number 26040-06 between CONTROL TRACK OUTPUT J22, on the inner test panel of the power and servo unit, and the record input bnc of the channel to be used on the rear of the appropriate electronics tray. (See Figures 2-2 and 2-3A, B and C.

To use this control track signal to control the servo, connect a jumper cable Ampex part number 26040-06 from CONTROL TRACK IN, J23, on the inner test panel to the channel output connector of the selected channel on the reproduce electronics tray. A jumper card (Ampex part number 1802477) must be utilized in place of a reproduce amplifier pwa when control track operation is desired.

EXTERNAL FREQUENCY STANDARD CONNECTION

If the operator desires, an external frequency standard may be substituted for the normal capstan speed reference signal. The external frequency source is connected to EXT FREQ STD J24 on the inner test panel, and the switch adjacent to J24 is set at EXT.

SEARCH OPERATION

An appropriate cable and attachment instructions for use with a Systron Donner Model SD8140 Time Code Generator is available (Ampex 1802273). The cable is connected to the SEARCH receptacle J6 of the power and servo unit. The schematic (Ampex 1248017), to interface the Time Code Generator with the FR3010 recorder/reproducer is also available.

ES-200 BUFFER CARD PWA

To assure proper operation of the FR3010 recorder/reproducers with the ES-200 Electronics, a buffer card pwa must be installed in the power supply section of the ES-200 electronics tray. The buffer card pwa, Ampex 1801914, is installed in the slot at the extreme left rear of each electronics tray.

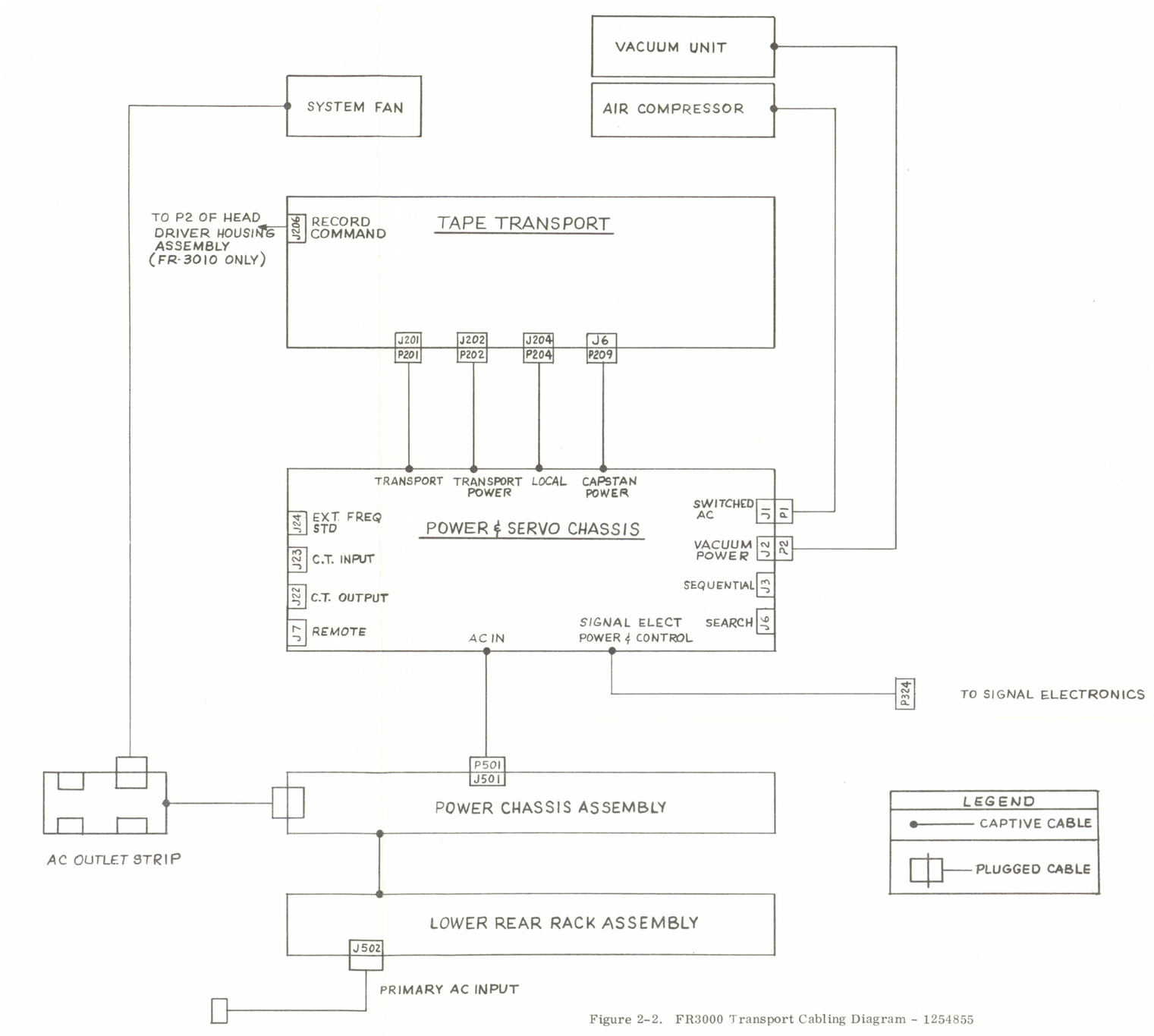

Figure 2-2. FR3000 Transport Cabling Diagram - 1254855

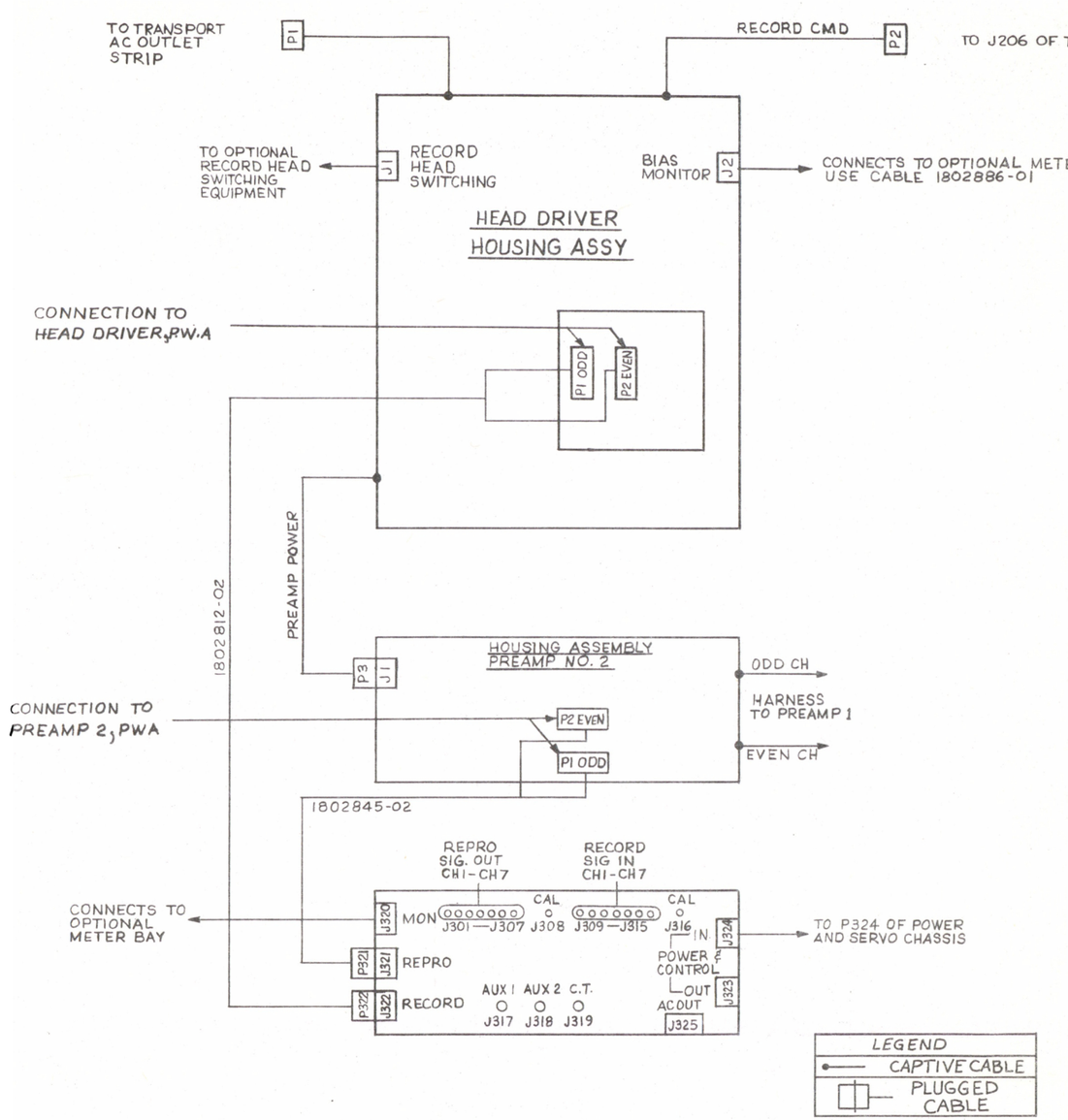

Figure 2-3A. 7 Channel Record-Reproduce FR3010 Signal Electronics Cabling Diagram - 1254848

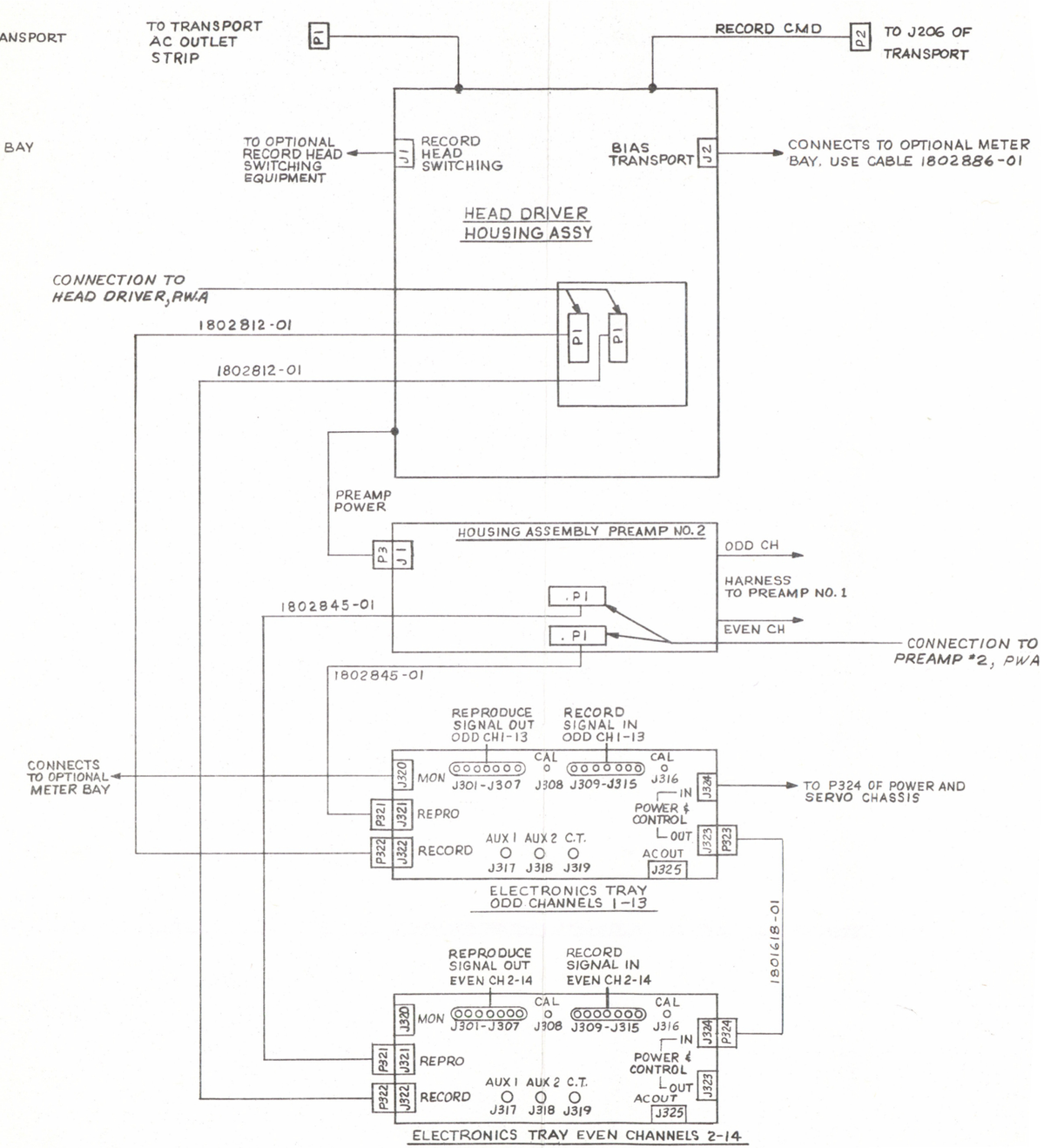

Figure 2-3B. 14 Channel Record-Reproduce FR3010 Signal Electronics Cabling Diagram - 1254848

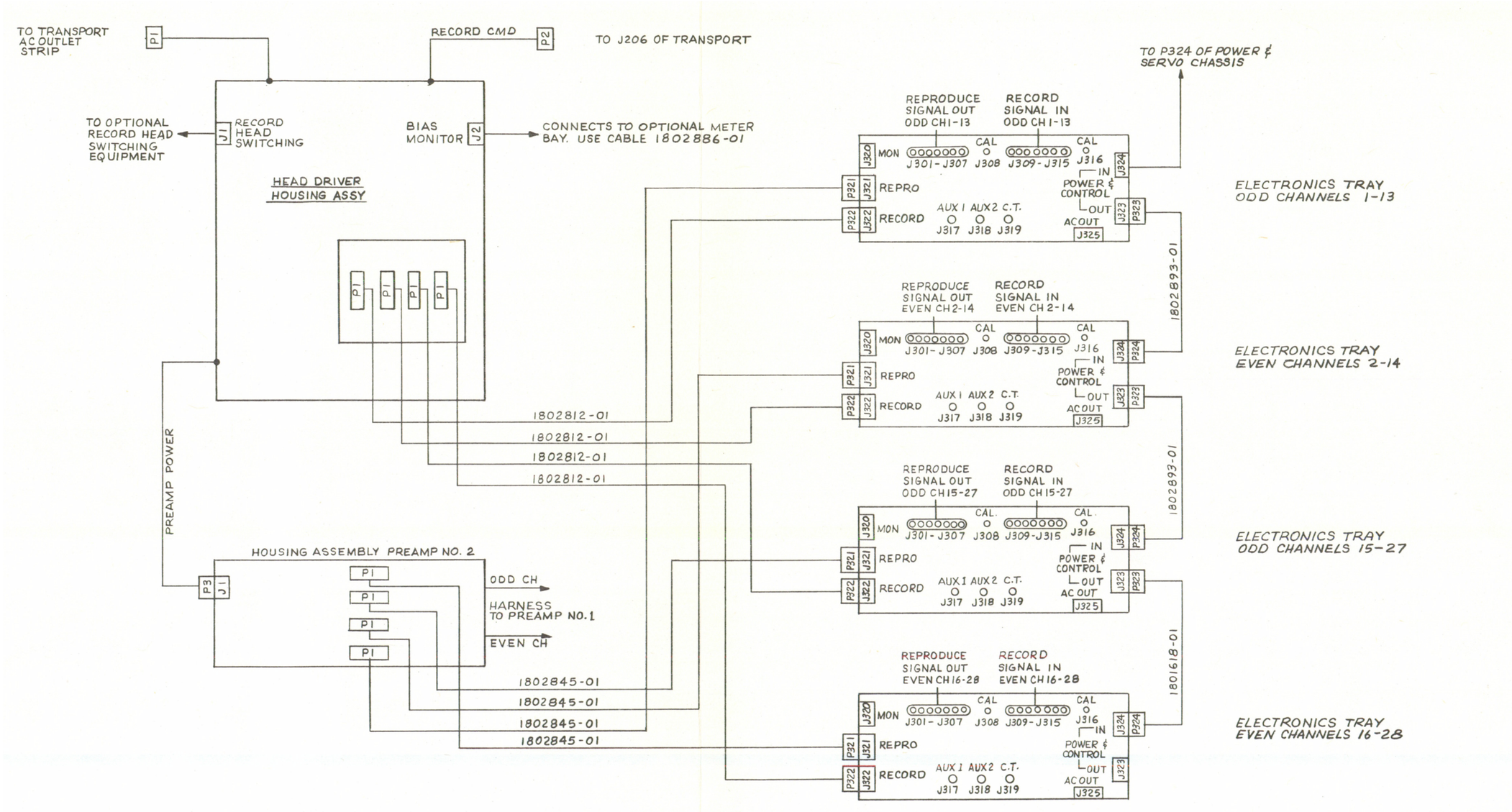

Figure 2-3C. 28 Channel Record-Reproduce FR3010 Signal Electronics Cabling Diagram - 1254848

SECTION 3
OPERATION

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OPERATION

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GENERAL

The FR3000 series Recorder/Reproducers are operated from three separate panels:

a. A power panel located at the bottom front of the rack cabinet.

b. A control panel mounted on the front right of the tape transport.

c. An inner test panel (part of the power and servo unit) mounted on the inside of the rack cabinet behind the tape transport. Alignment and adjustment controls for the various modules of the recorder/reproducer are described in section 9 of the FR3000 Transport Maintenance Manual 1802854.

POWER PANEL CONTROL AND INDICATOR

The components on the power panel are shown in Figure 3-1. Their type and functions are described in Table 3-1. The associated Schematic Diagram 1254747 (part of the power chassis assembly) is to be found in Section 7 of the FR3000 Transport Maintenance Manual 1802854.

Table 3-1. Power Panel Control and Indicator Functions

CONTROL OR INDICATOR	TYPE	REF	FUNCTION
Ac power	Circuit breaker	CB501	Applies ac power to the power and servo unit, the +30V pilot power supply, the power supplies in the electronics trays, and the convenience strip and outlets provided in the standard rack cabinet.
Ac power	Lamp	DS501	Indicates that ac power is applied as described for circuit breaker CB501 above.
Fuse	Fast Blo 10A-250V	F501	Provides overload protection for the rear (inside cabinet) AC outlet.
Fuse	Fast Blo 10A-250V	F502	Provides overload protection for the front AC outlet. (The front outlet is not switched by the circuit breaker CB501.)

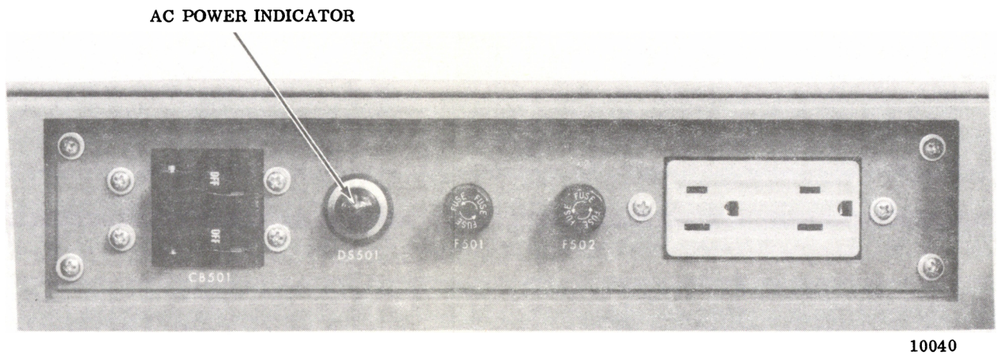


Figure 3-1. Power Panel Control and Indicator

CONTROL UNIT CONTROLS AND INDICATORS

The controls and indicators on the control unit are shown in Figure 3-2. Their type and functions are described in Table 3-2. The associated Schematic Diagram 1254494 is to be found in Section 3 of the FR3000 Transport Maintenance Manual 1802854.

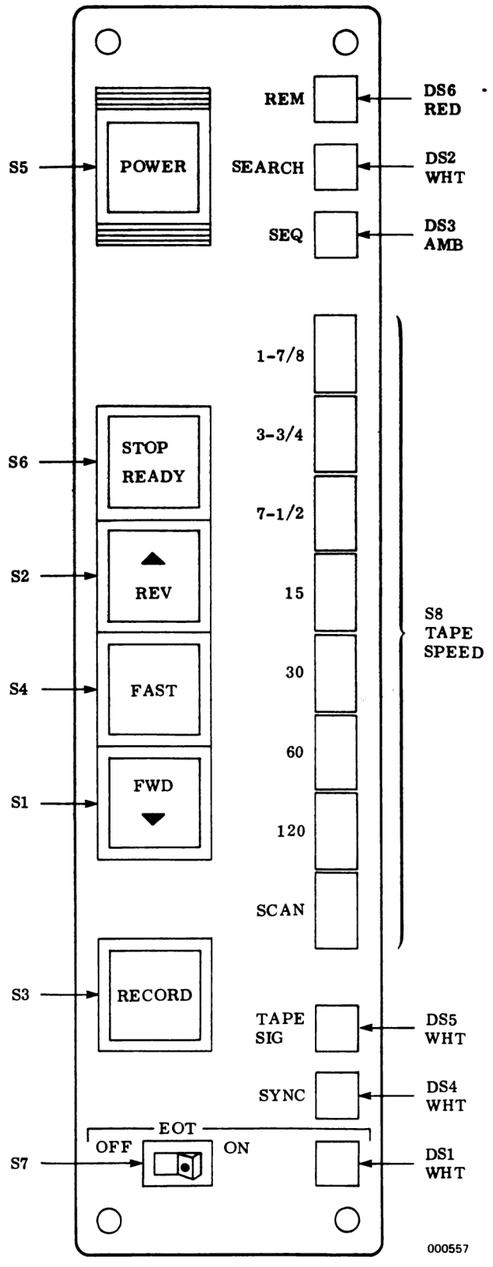


Figure 3-2. Control Unit Controls and Indicators

Table 3-2. Control Unit Controls and Indicators

CONTROL OR INDICATOR	TYPE	REF.	FUNCTION
POWER (transport)	Lighted push on/ push off push-button Lamps	S5 DS1 DS2	When the POWER pushbutton is initially pressed, power is applied to the tape transport, the power and servo unit controls, the vacuum blower, the compressor, and the POWER pushbutton is back-lighted. When pressed a second time, it removes the ac power from these units. If tape is threaded the STOP READY pushbutton also lights up when ac power is applied. Additionally, the footage counter (if fitted) will also come on when ac power is applied.
▼ (Forward)	Lighted pushbutton Lamps	S1 DS1 DS2	When the FWD pushbutton is pressed, it places the tape transport in the forward mode and the FWD pushbutton is back-lighted. In this mode the tape moves from the upper reel to the lower reel. When correct tape speed is reached, the SYNC light also comes on (including SCAN speed).
FAST	Lighted pushbutton Lamps	S4 DS1 DS2	When the FAST pushbutton is pressed simultaneously with the FWD push-button, it places the tape transport in the fast forward mode and the FAST and FWD pushbuttons are back-lighted. When it is pressed simultaneously with the REV pushbutton, it places the tape transport in the fast reverse mode and the FAST and REV pushbuttons are back-lighted.
▲ (Reverse)	Lighted pushbutton Lamps	S2 DS1 DS2	When the REV pushbutton is pressed, it places the tape transport in the reverse mode and the REV pushbutton is back-lighted. In this mode the tape moves from the lower reel to the upper reel. When correct tape speed is reached, the SYNC light also comes on (including SCAN speed).
STOP READY	Lighted pushbutton Lamps	S6 DS1 DS2	When the STOP READY pushbutton is pressed, tape movement stops, and the pushbutton is back lit. When the STOP READY pushbutton is lit, it indicates that the tape transport is in the ready mode, that is: a. Correct vacuum in chamber. b. Control logic and reel servo circuits are activated. c. Brake solenoid actuated releasing brakes. d. Tape threaded.
RECORD	Lighted pushbutton Lamps	S3 DS1 DS2	When the RECORD pushbutton is pressed simultaneously with either the FWD or REV pushbutton, the transport is placed in the Record mode. The FWD or REV and the RECORD pushbuttons will be lit. When the REC TEST switch on the inner test panel is set to ON, the STOP READY lights and the RECORD pushbuttons are back lit. In this condition the tape may not be moved, but that the record electronics are energized. Additionally, the SYNC light comes on to indicate that FM Squelch has been removed which facilitates electronics-to-electronics (E-to-E) calibration without pulling tape.

Table 3-2. Control Unit Controls and Indicators (Cont)

CONTROL OR INDICATOR	TYPE	REF	FUNCTION
EOT	Rocker switch Lamp	S7 DS1	When the EOT rocker switch is set to the ON position, it places the end of tape sensors in the circuit and the EOT indicator lights up. Tape motion stops just prior to depletion of tape on either reel. When set to OFF, the end of tape sensors are disabled and the indicator light is off. Tape will run completely off the reel and then the transport will stop.
TAPE SIG indicator	Lamp (white)	DS5	When TAPE SIG indicator is lit it indicates that the control track signal level from the pwa P107 is sufficient to control the capstan servo. (The SYNC switch (see Figure 3-3) must be in the TAPE position).
SYNC indicator	Lamp (white)	DS4	When the SYNC indicator is lit, it indicates that the capstan/tape speed is correct and synchronized against the prime reference frequency at the selected tape speed. When the SYNC lamp alone is lit, the capstan servo is synchronized with the tachometer. When the SYNC and TAPE SIG indicators are on, the capstan servo is synchronized with the control track signal from tape.
SEQ indicator	Lamp (amber)	DS3	When the SEQ indicator is lit, it indicates that the SEQUENTIAL switch on the inner test panel is set at ON. Additionally, it indicates that the transport is ready to send or accept a sequential record command.
SEARCH indicator	Lamp (white)	DS2	When the SEARCH indicator is lit, it indicates that the SEARCH switch on the inner test panel is set at ON.
REMOTE indicator	Lamp (red)	DS6	When the REMOTE indicator is lit, indicates that the control switch on the inner test panel is set at REMOTE and a remote control assembly is connected to the system. The POWER pushbutton (green) on the transport is off, the STOP READY light is on (providing tape properly threaded) and the control of the transport modes of operation is made via the remote control unit only.
Tape speed visual indicator	8-position interlocked push-buttons. **	S8	Permits selection of any one of eight indicated tape speeds, 1-7/8, 3-3/4, 7-1/2, 15, 30, 60, 120 or SCAN (240 ips) **Mechanically interlocked such that any individual pushbutton when pressed cancels out the selection of any other switch.

INNER TEST PANEL CONTROLS AND INDICATORS

The controls and indicates on the inner test panel are shown in Figure 3-3. Their type and functions are described in Table 3-3. The associated Schematic Diagram 1254487 is to be found in Section 7 of the FR3000 Transport Maintenance Manual 1802854.

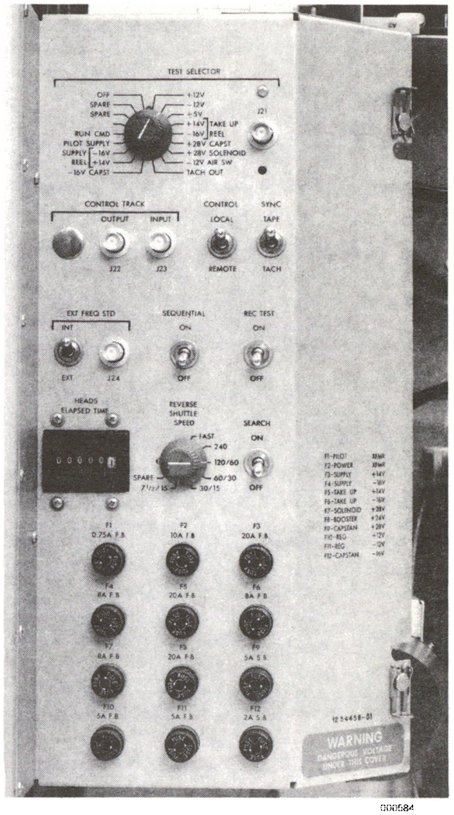


Figure 3-3. Inner Test Panel Controls and Indicators

Table 3-3. Control Unit Controls and Indicators

CONTROL OR INDICATOR	TYPE	REF	FUNCTION
TEST SELECTOR *	Rotary switch	S1	Used to check the equipment for the presence of proper voltages and signals as indicated.
CONTROL (LOCAL/REMOTE)	Toggle switch	S3	When set at LOCAL, permits exclusive operation of the equipment from the control unit on the tape transport. When set at REMOTE, permits exclusive operation of the equipment from a remote control unit connected through a cable to REMOTE CONTROL receptacle J7 on the power and servo unit.

Table 3-3. Control Unit Controls and Indicators (Cont)

CONTROL OR INDICATOR	TYPE	REF	FUNCTION
SYNC	Toggle switch	S4	When set at TAPE, selects the control track from tape as the capstan servo input. When set at TACH, selects the capstan tachometer as the capstan servo input. If the TAPE signal should disappear, the system will automatically switch to TACH regardless of the position of S4.
EXT FREQ STD	Toggle switch	S5	Selects the reference frequency source. When set at INT, the internal crystal oscillator is used to synchronize the capstan servo speed. When set at EXT, an external reference frequency source is used. The external reference frequency is connected to J24. If the external reference frequency is not connected and switch S5 is set to EXT, the transport will not pull tape at speeds of 1-7/8 to 240 (SCAN) ips.
SEQUENTIAL	Toggle switch	S6	When set at ON, permits equipment to operate sequentially with another FR3010 via the sequential cable. When set at OFF, equipment operates as an independent recorder/reproducer.
REC TEST	Toggle switch	S7	When set to ON, disables all tape motion modes but enables the record electronics to permit the check and setting up of the record system without moving tape. Additionally, the squelch function (out-of-sync inhibit) is removed from the FM demodulator, making provision for E-to-E operation. When set to OFF, enables the normal operating modes.
REVERSE SHUTTLE SPEED	7-position rotary	S8	Permits selection of a reverse shuttle speed when in the shuttle mode. The SHUTTLE and REV SHUTTLE SPEED SW on the optional footage counter at the top of the tape transport must be set to on. (The REV SHUTTLE SPEED SW is located on the rear of the footage counter assembly - inside transport.)
SEARCH	Toggle switch	S9	When set at ON, the SEARCH indicator on the control unit lights. If a time code generator (tcg) is connected to the FR3010, it also permits the tcg to control the operation of the FR3010.
HEADS ELAPSED TIME	Meter	M1	Indicates cumulative time of tape motion past the heads (Run Time).

*S2 Not Used

GENERAL

This section contains instructions for the operation (including preoperation) of the FR-3000 series Recorder/Reproducers. To ensure proper operation the preoperational procedures below should be carefully noted.

PREOPERATIONAL PROCEDURES

Prior to starting the system, the following preoperational procedures should be performed.

PREVENTIVE MAINTENANCE

Determine that the recorder is within the preventive maintenance schedule as described in Section 6.

TAPE SELECTION FOR RECORDING DATA

Select a reel of tape that has been bulk-erased. When recording new data, bulk-erasure of the tape will ensure achieving optimum performance. (The recommended tape is AMPEX type A786 or equivalent for 2.0/1.5 wideband systems and AMPEX type A766 or equivalent for Intermediate band recorder/reproducers.)

TAPE REEL INSTALLATION

Tape reel loading is accomplished with the transport power off. Place a full reel of tape on one hub of the tape transport and an empty reel on the other. For forward operation on the FR-3000 series Recorder/Reproducers, the supply reel (the full reel) must be on the upper reel hub and the takeup reel (the empty reel) on the lower reel hub. For reverse operation, simply reverse the reel positions. Each tape reel is installed by seating it firmly against the flange of the reel hub and tightening the holddown knob by turning it in a clockwise direction.

TAPE THREADING

The tape threading path is shown in Figure 3-4. The procedure for threading the tape is as follows:

NOTE

For proper recording and reproducing, the tape must be threaded with the dull side (oxide surface) facing the headstack.

a. Grasp edge and swing the vacuum chamber cover away from the vacuum chambers.

b. Swing the head cover out as far as it will go, revealing the heads.

c. Pull a length of tape from the upper reel, past the upper roller guide, down between the glass plate and the upper guide pin (leave a large loop of tape.

d. Thread the tape loosely in the head-capstan-air guide areas as shown in Figure 3-4. DO NOT FORCE the tape in between the capstan and heads or tape edge damage may result. To seat the tape correctly and to remove any tape loops rotate the capstan slowly in a clockwise direction while pulling the free end of the tape lightly.

e. Insert the tape between the glass plate and the lower guide pin. Pull the tape past the lower roller guide.

f. Hold the end of the tape to the lower reel hub through one of the reel flange slots. Wind the remaining tape onto the lower reel counterclockwise.

g. Leave a loop of tape in each of the upper and lower vacuum chambers. Close the vacuum cover over the vacuum chambers and the head cover over the head assembly. Use care not to pinch the wires protruding from the head stacks when closing the head cover.

MODES OF OPERATION

The recorder will operate in any of the standard modes by pressing the appropriate pushbutton on the control unit. These modes are record, forward and reverse. Additionally when the FAST pushbutton is pressed with either the forward or reverse pushbutton, the fast forward or fast reverse mode is selected. The following optional modes are also available, search, sequential and shuttle. These modes are selected by toggle switches on the inner test panel. If the equipment fails to operate properly in any of these modes, a technician should be called.

INITIAL SETTINGS

After turning on the ac power to the recorder by setting circuit breaker CB501 to ON, set the inner test panel switches to the following positions:

Switch	Position
CONTROL	LOCAL
SEQUENTIAL	OFF
REC TEST	OFF
SEARCH	OFF
EXT FREQ STD	INT
SYNC	TAPE OR TACH

On the control unit, set the EOT switch to ON.

POWER APPLICATION

To apply power to the tape transport, turn the main ac power circuit breaker CB501 to ON. The cooling fans

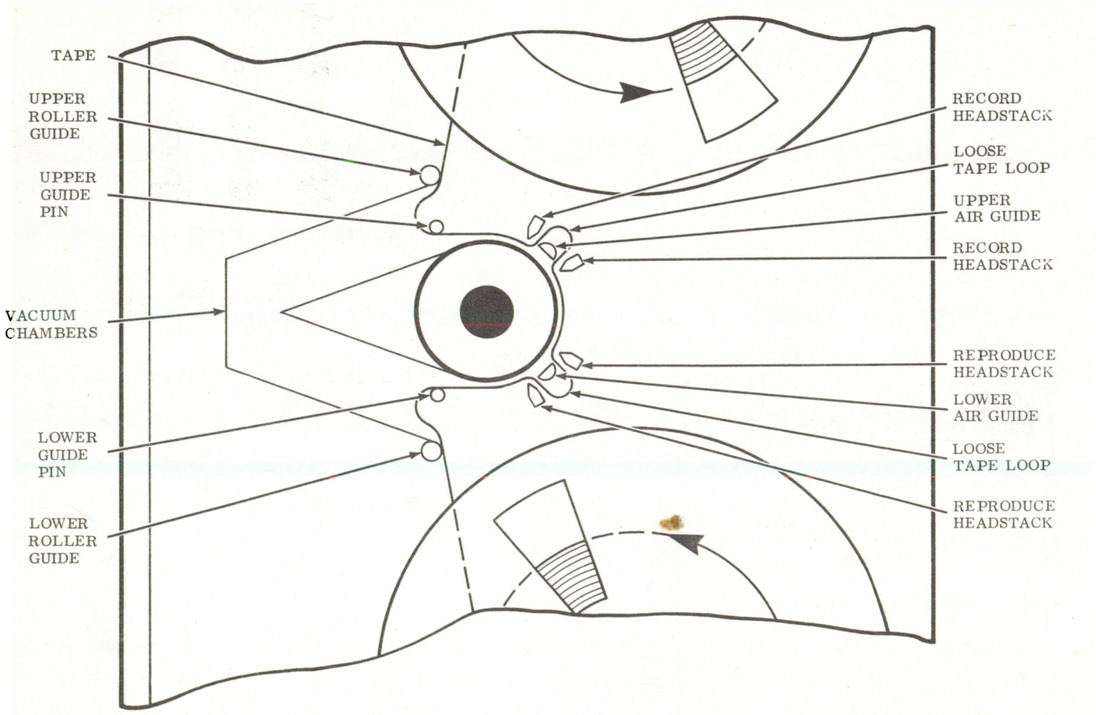


Figure 3-4. Tape Threading Path

will come on and the signal electronics will be energized. The red ac power indicator DS501 will be on. Press the POWER pushbutton. The lamps behind the POWER pushbutton will light (green) and the sound of the air compressor and vacuum blower coming up to speed is audible. The brake solenoids are activated and tape is pulled into each vacuum chamber. The STOP READY lamp will light (white) indicating that the system is in a READY state.

TAPE SPEED SELECTION

Standard tape speeds are selected by pressing one of the speed selection pushbuttons on the left side of the control unit (see Figure 3-2). The number next to the pushbutton indicates the tape speed that will be selected by pressing that pushbutton. When the speed pushbutton is pressed, a green window in the pushbutton will appear. This green window will remain visible until another speed pushbutton is pressed.

RECORD/REPRODUCE LEVELS - GENERAL

Normally tape recorder/reproducer systems are calibrated for operating input and standard output levels of 1V rms. These levels are defined below for direct and FM systems. When, however, it is desired to recalibrate a system to new input and output levels (direct record level, direct reproduce output level, FM modulator deviation and FM demodulator output level) the operator should refer to the procedures which follows.

DEFINITIONS - DIRECT

OPERATING INPUT LEVEL. Any data input level to the record amplifier, which falls between the minimum and maximum levels listed on the specification sheet, shall be known as the OPERATING INPUT LEVEL.

STANDARD RECORD LEVEL. The Record Level control is adjusted with a given input signal to produce a signal at the output of the reproduce amplifier which contains 1% third order harmonic distortion. This input signal shall be known as the STANDARD RECORD LEVEL signal. (This is similar to "Normal Record Level" as defined in IRIG 106-73.)

STANDARD OUTPUT LEVEL. The Reproduce Output Level control is normally adjusted to produce an output signal amplitude of 1 volt rms, as measured across the proper terminating impedance, when reproducing a STANDARD RECORD LEVEL signal. This signal shall be known as the STANDARD OUTPUT LEVEL signal. (Values other than 1 volt rms may be used, but degradation in signal-to-noise or distortion may result.)

OPERATING INPUT LEVEL UNKNOWN. Equipment is normally adjusted at the factory utilizing 1 volt rms for the STANDARD RECORD LEVEL. On site alignment may be made with a test signal generator producing either the sites' preferred STANDARD RECORD LEVEL or the factory STANDARD RECORD LEVEL.

DEFINITIONS - FM

STANDARD INPUT SIGNAL LEVEL. A standard input signal is applied to the fm record amplifier for adjustment purposes. It is defined as:

a. that input signal level which deviates the fm modulator from its center carrier frequency (ccf) ±30% for WII bipolar operation. If the fm modulation is configured for unipolar operation the fm carrier frequency will be deviated positive or negative 60% for WII operation.

b. that input signal level which deviates the fm modulator from its center carrier frequency (ccf) ±40% for WIL bipolar operation. If the fm modulation is configured for unipolar operation the fm carrier frequency will be deviated positive or negative 80% for WIL operation.

The fm standard input signal levels normally used for factory adjustments are:

a. A standard dc input at positive or negative 1.414V.

b. A standard ac input at 1V rms.

STANDARD OUTPUT LEVEL. The reproduce output level control is normally adjusted to produce an output signal amplitude of 1V rms as measured across the proper terminating impedance, when reproducing a STANDARD INPUT SIGNAL LEVEL. This signal is known as the STANDARD OUTPUT LEVEL. (Values other than 1 volt rms may be used, but degradation in signal-to-noise or distortion may result.)

DIRECT RECORDING/REPRODUCING MODES OF OPERATION

RECORD MODE

To record data proceed as follows: (when high density PCM electronics is being used, refer to Ampex manual supplement 1812389 for recording procedures).

a. Ascertain that a buffer card (Ampex 1801914) is in position in each signal electronic tray.

b. Connect the data signals to be recorded to the appropriate record input connectors on the electronics trays (see Figure 3-5).

c. If control track recording is desired, an optional control track printed wiring assembly must be installed in J107 of the power and servo unit. In addition a jumper cable must be connected between CONTROL TRACK OUTPUT. J22, on the inner test panel (see Figure 3-3) and the appropriate RECORD INPUT bnc, on the rear of the electronics tray set the record amplifier input impedance to 75 ohms (see Figure 3-6).

d. Monitor the data or test signal input to each connector with a suitable oscilloscope or meter to ensure correct record signals. The input sensitivity and impedance of each record module is determined by inserting jumpers in the module as shown in Figure 3-6. (See paragraph titled "Changing Input Sensitivity Ranges and Impedances.") Record level control adjustment is discussed in paragraph titled "Record Level Control Adjustment." Do not change Record or Reproduce level settings without consulting the reference paragraphs.

e. Ascertain that all switches are set as listed in the paragraph titled "Initial Settings."

f. Apply power.

g. Select the desired tape speed.

h. Simultaneously press the RECORD and forward pushbuttons.

NOTE

In the forward direction only, the recorded signal from each channel may be monitored at the reproduce output connectors, using a suitable meter for amplitude or an oscilloscope for waveform comparison.

RECORD LEVEL CONTROL ADJUSTMENT. If the record input signal level is different in amplitude from that for which the equipment was last calibrated, or the calibration level is unknown, the REC LEVEL control must be adjusted. Do not adjust the REC LEVEL control to compensate for changes in output load. If the new input amplitude is not within the input sensitivity range for which the record module is jumpered (see Figure 3-6 for the ranges), a different range must be selected, as detailed below. In order to adjust the REC LEVEL control, the operator must know the full scale reproduce output level for which the reproduce amplifier is calibrated (the STANDARD OUTPUT LEVEL). To adjust the REC LEVEL control proceed as follows:

a. Operate the system in the forward record mode, following steps a through f of the Record Mode.

b. Monitor the reproduce output signal with a suitable oscilloscope or meter (properly terminate the reproduce output).

c. Set the amplitude of the test input signal to the maximum level to which the data signal is to be recorded.

d. Adjust the REC LEVEL control on the direct record amplifier until the output is equal in amplitude to the STANDARD OUTPUT LEVEL (see Figure 3-7.)

CHANGING INPUT SENSITIVITY RANGES AND IMPEDANCES. The direct record electronics has three input sensitivity ranges and three input impedances as listed in Figure 3-6. These ranges and impedances are selected by jumpers which plug into appropriate positions on the direct record amplifier. To change from one range or impedance to another, proceed as follows:

a. Set the ac power circuit breaker CB501 to OFF.

b. Remove the direct record amplifier to be changed.

c. Arrange jumpers on the module to obtain the desired input sensitivity and impedance as illustrated in Figure 3-6.

d. Replace the direct record amplifier, set circuit breaker CB501 to ON, and continue normal operation. Perform the RECORD LEVEL CONTROL ADJUSTMENT prior to continuing normal operation.

REPRODUCE MODE

To reproduce data proceed as follows: (when high density pcm electronics is being used, refer to Ampex manual supplement 1812389 for reproducing procedures).

a. Connect an oscilloscope or suitable monitoring device to the reproduce output connectors. The connectors used will be determined by the channels previously recorded. Connectors for channels are identified on Figure 3-5. Do not change the record or reproduce level settings without referring to paragraphs titled "Record Level Control Adjustment" and "Changing Input Sensitivity Ranges and Impedances". If control track is to be used for capstan sync, an optional Control track pwa must be installed in J107 (Power and Servo Unit). If a control track was recorded during the record mode, the reproduced Control track signal must be patched into J23, CONTROL TRACK INPUT (located on the inner test panel - see Figure 3-3).

b. Set the SYNC switch to TAPE.

c. Set the switches as outlined under paragraph titled "Initial Settings."

d. Apply power.

e. Select the desired tape speed.

f. Press the forward pushbutton. Previously recorded data and the control track signals should be displayed on the monitoring device. If the reproduced level is not correct, refer to paragraph titled "Reproduce Level Adjustment" for the proper procedure. If the reproduced signal is distorted or shifted in dc level refer to Section 8 of this manual for Adjustment Procedures.

g. If a control track is being properly reproduced, the TAPE SIG indicator will light. If only the TACH indicator is lit, the control track signal is not being properly reproduced, or a point has been reached where the control track was not recorded on tape or the signal has not been connected as per a.

h. Press the STOP pushbutton to stop the tape movement on the transport.

REPRODUCE LEVEL ADJUSTMENT. The reproduce gain (Level) control should be adjusted only to compensate for changes in output load requirements, not for changes in input level. In order to adjust the output GAIN ADJ control, the operator should know the maximum record input level range for which the channel is to be calibrated (see table in Figure 3-6). The operator should also know that the record level control is correctly adjusted (see Record Level Control Adjustment). To adjust the reproduce GAIN ADJ control, proceed as follows:

a. Operate the system in the forward record mode, following steps a through h of procedures under Record Mode Operation while applying the STANDARD RECORD LEVEL for which the channel to be adjusted is jumpered and calibrated.

b. Monitor the reproduce output data with a suitable oscilloscope or meter.

c. Connect the new load to the output connector.

d. Adjust the GAIN ADJ control on the reproduce module to produce the desired STANDARD OUTPUT LEVEL. (See Figure 3-8.)

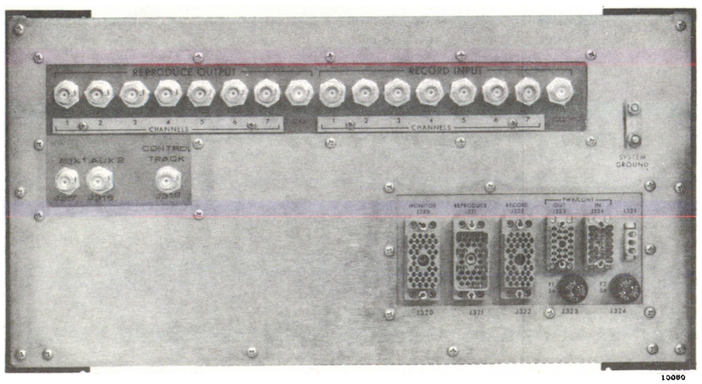


Figure 3-5. Signal Electronics Tray, Rear View

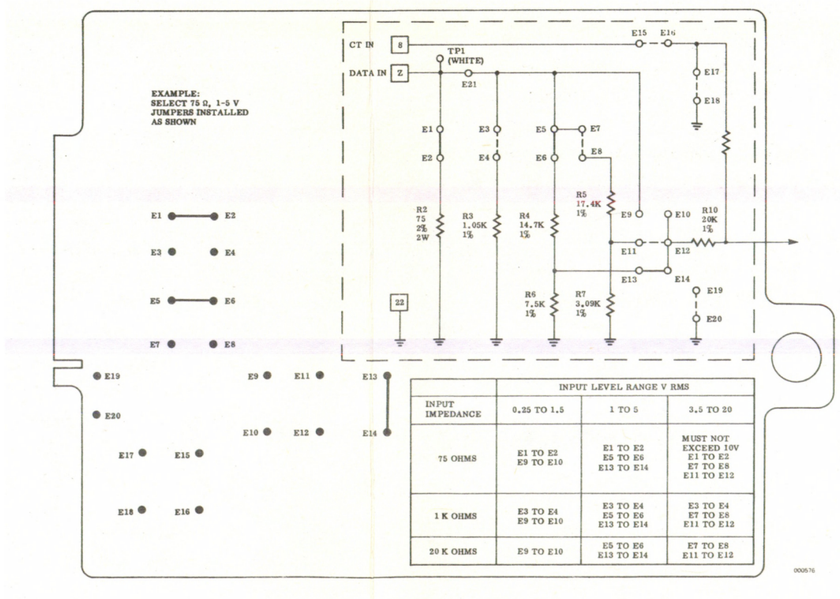


Figure 3-6. Direct Record Amplifier, Showing Jumper Positions

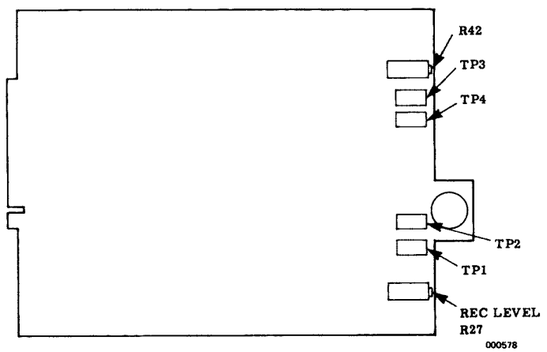


Figure 3-7. Direct Record Amplifier Adjustments

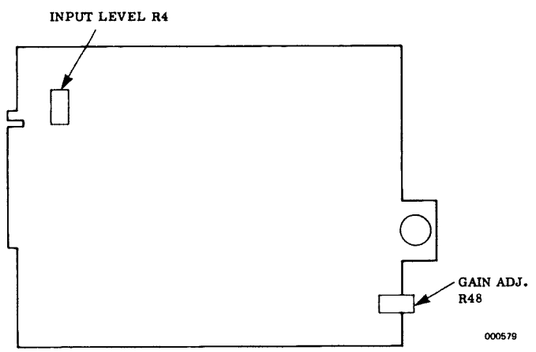


Figure 3-8. Direct Reproduce Amplifier Adjustments

FM RECORDING/REPRODUCING MODES OF OPERATION

RECORD MODE

To record data proceed as follows: (when high density PCM electronics is being used, refer to Ampex manual supplement 1812389 for recording procedures).

a. Ascertain that a buffer card (Ampex 1801914) and +17V Reference Power Supply pwa (1801606) is in position in each signal electronic tray.

b. Connect the data signals to be recorded to the appropriate record input connectors on the electronics trays (see Figure 3-5).

c. Monitor the data or test signal input to each connector with a suitable oscilloscope or meter to ensure correct record signals. The input sensitivity and impedances of each FM modulator module is determined by inserting jumpers as shown in Figure 3-9. (See paragraph titled "Changing Input Sensitivity Ranges and Impedances.") Modulator deviation level control adjustment is discussed in paragraph titled "FM Modulator Deviation Adjustment". Do not change modulator deviation or demodulator output level settings without consulting the reference paragraphs.

d. Ascertain that all switches are set as listed in the paragraph titled "Initial Settings."

e. Apply system and transport power.

f. Select the desired tape speed.

g. Simultaneously press the RECORD and forward pushbuttons.

NOTE

In the forward direction only, the recorded signal from each channel may be monitored at the reproduce output connectors, using a suitable meter for amplitude or an oscilloscope for waveform comparison.

FM MODULATOR DEVIATION ADJUSTMENT. If the record input signal level is different in amplitude from that for which the equipment was last calibrated, or the calibration level is unknown, the REC (DEVIATION) LEVEL control must be adjusted.

NOTE

If either the FM modulator or demodulator center carrier frequency adjusts have been moved then the modulator and demodulator must be completely recalibrated. Refer to Section 8 of this manual for FM calibration procedures.

If the new input amplitude is not within the sensitivity range for which the modulator is jumpered (see Figure 3-9), a different range must be selected. In order to adjust the REC (DEVIATION) LEVEL control, the operator must know the output level to which the FM demodulator is calibrated.

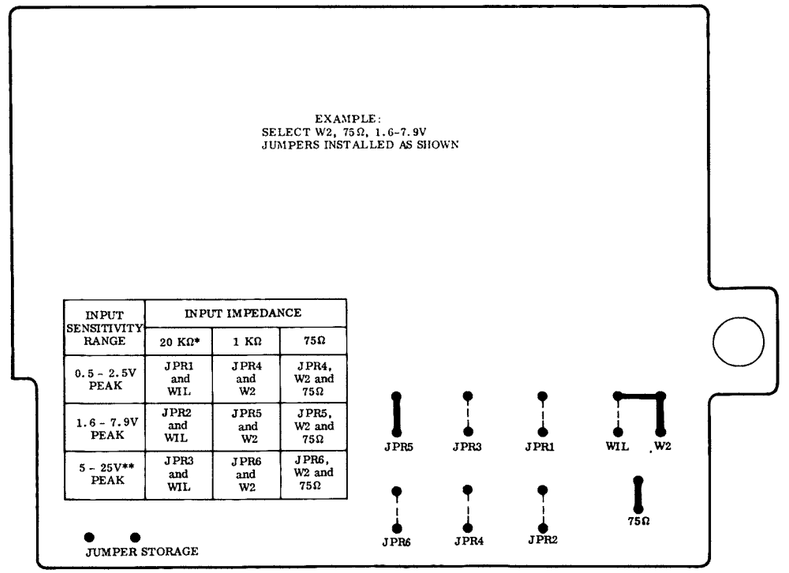
To adjust the REC (DEVIATION) LEVEL control proceed as follows.

a. Operate the system in the forward record mode, following steps a through f of the Record Mode.

b. Monitor the demodulator output signal with a suitable oscilloscope or meter. (Properly terminate the reproduce output).

c. Set the amplitude of the test input signal to the maximum level to which the data signal is to be recorded.

d. Adjust the REC (DEVIATION) LEVEL control on the FM modulator until the output of the demodulator is at the desired full scale level (STANDARD OUTPUT LEVEL). See Figure 3-10.



INPUT SENSITIVITY RANGE	INPUT IMPEDANCE		
	20 KΩ*	1 KΩ	75Ω
0.5 - 2.5V PEAK	JPR1 and WIL	JPR4 and W2	JPR4, W2 and 75Ω
1.6 - 7.9V PEAK	JPR2 and WIL	JPR5 and W2	JPR5, W2 and 75Ω
5 - 25V** PEAK	JPR3 and WIL	JPR6 and W2	JPR6, W2 and 75Ω

*The modulator may be operated at W2 bandwidth with 20 kΩ input impedance, but performance specifications are not guaranteed.
**For 75Ω input impedance, input level may not exceed 10V peak.

Figure 3-9. FM Modulator Showing Jumper Positions

CHANGING INPUT SENSITIVITY RANGES AND IMPEDANCES. The fm modulator has three input sensitivity ranges and three input impedances as listed in Figure 3-9. These ranges and impedances are selected by jumpers which plug into appropriate positions on the fm modulators. To change from one range or impedance to another, proceed as follows:

a. Set the ac power circuit breaker CB501 to OFF.

b. Remove the fm modulator to be changed.

c. Arrange jumpers on the module to obtain the desired input sensitivity and impedance as illustrated in Figure 3-9.

d. Replace the fm modulator, set circuit breaker CB501 to ON. Preform the FM Modulator Deviation Adjustment and continue normal operation

REPRODUCE MODE

To reproduce FM data proceed as follows:

a. Connect an oscilloscope or suitable monitoring device to the reproduce output connectors. The connectors used will be determined by the channels previously recorded. Connectors for channels are identified on Figure 3-5. Do not change the modulator deviation or demodulator output level settings without referring to paragraphs titled "FM Modulator Deviation Adjustment", "Changing Input Sensitivity Ranges and Impedances", and "FM Demodulator Output Level Adjustment."

b. Set the SYNC switch to TAPE.

c. Set the switches as outlined under paragraph titled "Initial Settings."

d. Apply power.

e. Select the desired tape speed.

f. Press the forward pushbutton. Previously recorded data should be displayed on the monitoring device. If the reproduced level is not correct, refer to paragraph titled "Demodulator Output Level Adjustment" for the proper procedure. If the reproduced signal is distorted or shifted in dc level refer to Section 8 of this manual for Adjustment Procedures.

g. Press the STOP pushbutton to stop the tape movement on the transport.

FM DEMODULATOR OUTPUT LEVEL ADJUSTMENT. The reproduce output level control should be adjusted only to compensate for changes in output load requirements, not for changes in input level. In order to adjust the output level control, the operator should know the maximum record input level range (see table in Figure 3-9) and the STANDARD INPUT SIGNAL LEVEL for which the channel is calibrated.

The operator should also know that the FM Modulator Deviation Control is correctly adjusted (see FM Modulator Deviation Adjustment). To adjust the reproduce output level control, proceed as follows:

a. Operate the system in the forward record mode, following steps a through g of procedures under Record Mode Operation while applying the STANDARD INPUT SIGNAL LEVEL for which the channel to be adjusted is jumpered and calibrated.

b. Monitor the reproduce output data with a suitable oscilloscope or meter.

c. Connect the new load to the output connector.

d. Adjust the OUTPUT LEVEL control on the reproduce module to produce the desired output level (the STANDARD OUTPUT LEVEL). See Figure 3-10.

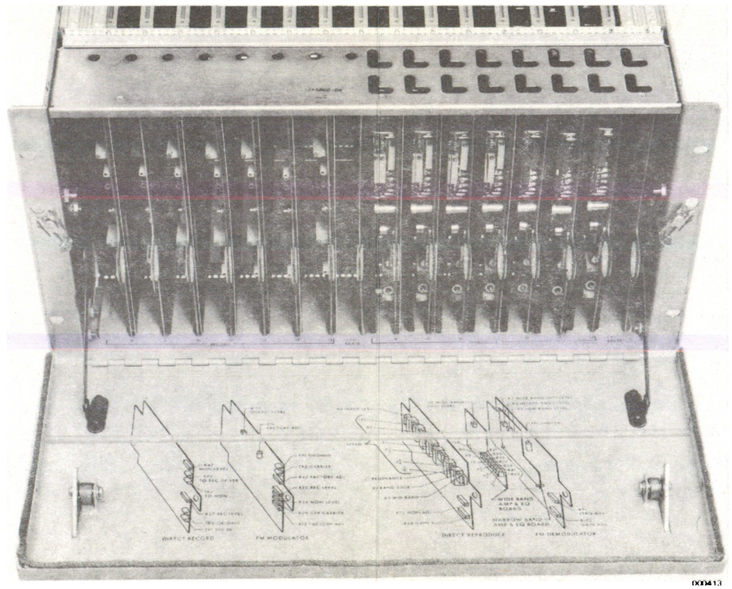


Figure 3-10. Signal Electronics Tray - Showing Signal Electronics Adjustment Callouts

FAST MODE OPERATION

The fast modes are used to move tape quickly from one reel to the other with minimum head-to-tape contact. To initiate fast forward or fast reverse either when the transport is stopped or while it is in the record or reproduce mode, press the appropriate pushbuttons. The transport will then proceed into the selected mode. If there is a direction change, the transport will stop and then proceed into the selected mode.

SEARCH MODE OPERATION

The search mode requires the attachment of a time code generator with a tape control unit to the equipment. This mode is similar to the reproduce mode except the speed of tape movement is controlled by the time code generator. The SEARCH switch on the inner test panel must be set to ON, which will cause the SEARCH indicator on the control unit to light. The search mode is initiated by pressing the forward pushbutton.

SEQUENTIAL OPERATION

Sequential operation involves the use of two recorder/reproducers. One is initially operated in the forward record mode while the other is in the STOP READY mode. To link the two recorders for sequential operation, a cable must be connected from the SEQUENTIAL receptacle, J3, on one recorder to the equivalent receptacle on the other recorder, and the SEQUENTIAL switch on the inner test panel of both recorders must be set at ON.

When the first recorder nears the end of its tape supply in the forward record mode, the second recorder is automatically started in the forward record mode. The first recorder continues to record until the end-of-tape is reached. If the first recorder is reloaded while the second is operating, the sequence can be extended indefinitely.

END-OF-TAPE SWITCH DURING SEQUENTIAL OPERATION

The EOT switch, on the control unit, may be set at OFF when operating in the sequential mode. This provides a maximum of redundantly recorded data because the end-

of-tape sensors are disabled, which permits data to be recorded until the tape runs off the reel. Setting the EOT switch to OFF in no way effects the sequential sensor.

When the EOT switch is set at ON and tape movement stops, as a result of the end-of-tape sensor action, there is no need to set the switch to OFF in order to move tape off the reel. Press the pushbutton that will wind the tape onto the desired reel.

SHUTTLE MODE

The shuttle mode, which is an automatic cycling operation, shuttles the tape between preselected points on the tape. The shuttle mode requires the use of a footage counter. To operate the recorder/reproducer in the shuttle mode, proceed as follows:

a. Place the recorder/reproducer in the fast forward mode and move the tape to a point where the cycling operation is to start.

b. Press the RESET (zero set) switch on the footage counter. This will place the footage counter to 00000 count.

c. Move the tape to a position where the cycling operation is to end.

d. Press the LIMIT switch on the footage counter to mark the end of the shuttle distance. (Another version of the footage counter has a digital thumbwheel switch to set the end of shuttle distance in feet.

e. Select the desired forward tape speed on the control unit.

f. If the desired reverse shuttle speed is the same as the forward speed, then place the SHUTTLE switch on the footage counter in the on position (downward) and proceed to step h.

g. If the desired reverse shuttle speed is different from the forward speed, then set the REVERSE SHUTTLE SPEED switch on the inner test panel to the desired reverse shuttle speed. Set the REV SHUTTLE SPEED SW at the rear of the footage counter assembly (on the back of the transport baseplate) to the on position. Proceed to step h.

h. Press the REV pushbutton. The tape will automatically shuttle between the two preselected points on tape.

i. To terminate the shuttle operation, press the STOP READY pushbutton and set the SHUTTLE switch to the OFF position and the REV SHUTTLE SPEED SW to the OFF position.

REMOTE OPERATION

Remote operation is selected by setting the CONTROL switch on the inner test panel to REMOTE. Connect a cable from the remote control unit to the REMOTE receptacle, J7, on the power and servo unit behind the tape transport. When a remote control unit is connected to J7 through a cable and the CONTROL switch is set at REMOTE, the REMOTE indicator on the tape transport control unit should light.

All of the tape transport functions that are normally controlled from the tape transport control unit can now be exclusively controlled from the remote control unit.

TAPE REMOVAL

Following the recording or reproducing of data, rewind the tape onto the upper reel. When the end-of-tape sensors stop the tape, press the FAST/REV pushbuttons until the tape completely rewinds onto the upper reel. Press the POWER pushbutton to turn off power. Remove the reel of tape by turning the reel holddown knob counterclockwise until the reel is released. Pull the reel of tape straight away from the tape transport.

CAUTION

TO AVOID DAMAGING PRECISION REELS, DO NOT LIFT OR HOLD THEM BY THE OUTER EDGES OF THE FLANGES.

OPERATING COMMENTS

The small air switch, S202, located behind the vacuum chambers, is adjusted to sense the absence of tape in the vacuum chamber immediately. This adjustment is outlined in Section 9, page 9-4 of the FR3000 Transport Maintenance Manual 1802854.

SECTION 4
SYSTEM DESCRIPTION

SECTION 4

SYSTEM DESCRIPTION

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LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (Cont)

SECTION 4
SYSTEM DESCRIPTION

GENERAL

Figures 4-1, 4-2 and 4-3 and the System Block Diagram Figure 4-4 indicate that the functional elements of the FR3010 recorder/reproducer may be divided into two principle areas:

a. The tape transport and control circuitry.

b. Signal Electronics.

The function of the individual components within these areas are briefly described below.

A detailed description of the transport components including theory of operation, schematic diagrams, parts lists, adjustment procedures, etc., may be found in the FR3000 Transport Maintenance manual, 1802854.

A detailed description of the signal electronics components including theory of operation, schematic diagrams, and parts lists may be found in the FR3010 Signal Electronics manual, 1802855. Adjustment and maintenance procedures for the signal electronics (since they require the use of a tape transport) are contained in this manual, in the following sections:

Preventive Maintenance	Section 6
Performance Checks	Section 7
Adjustment Procedures	Section 8
Troubleshooting	Section 9
Removal and Replacement of Components	Section 10
Test Equipment and Special Tools	Section 11

TAPE TRANSPORT AND CONTROL CIRCUITS

GENERAL

The tape transport must move tape across the record and reproduce heads at a constant linear velocity with the least amount of disturbance to tape motion. It must also provide some means of tape storage (reels). It must have flexibility of tape speeds so that the operators may select a particular tape speed that will provide the necessary frequency response and recording time for their operation.

To this end the FR3010 has been designed so that the tape speed and tape tension are controlled with great precision. Seven tape speeds are provided 120, 60, 30, 15, 7 1/2, 3 3/4, and 1 7/8 ips in a forward and reverse direction. In addition fast forward and fast reverse speeds of more than 300 ips and a scan speed of 240 ips in the forward and reverse direction are also provided. Broken tape, end-of-tape, and tape tension are automatically sensed and sequential and remote control is available.

In order to meet these requirements the FR3010 tape handling mechanism is built on a baseplate subassembly which gives a rigid, precise reference to the various other subassemblies in proper relationships. The most critical subassemblies (capstan, head assemblies and vacuum chambers) are mounted on a precision plate which is part of the capstan assembly which in turn mounts on the back of the transport baseplate. The tape handling components project forward through a hole in the baseplate.

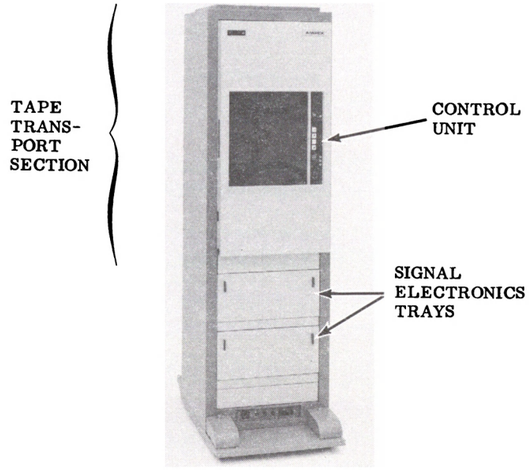


Figure 4-1. FR3010 Recorder/Reproducer

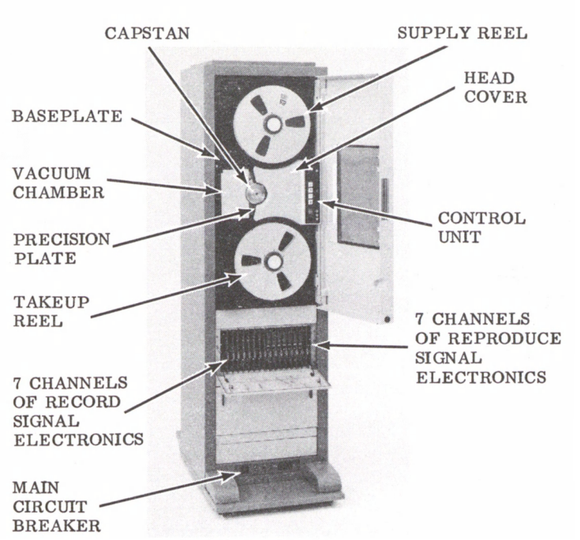


Figure 4-2. FR3010 Recorder/Reproducer - Front View Cover Doors Open

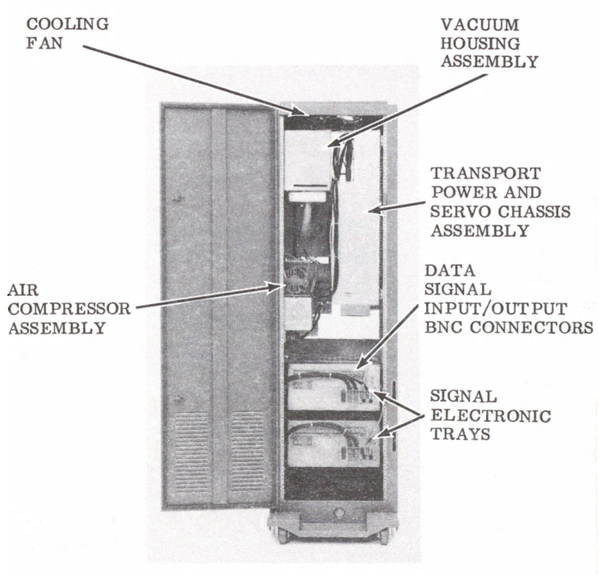


Figure 4-3. FR3010 Recorder/Reproducer - Rear View, Cabinet Door Open

CONTROL LOGIC

The functions of the tape transport, as well as some of the functions of the associated signal electronics, are controlled by logic circuits contained in the power and servo chassis. These circuits are controlled in turn by signals or switch closures from a control unit which mounts in an opening in the baseplate so that a control panel (or cluster) is accessible from the front of the transport.

The control logic also receives end-of-tape (stop) signals from photosensors associated with the tape reels. When sequential operation is selected, and the end of the tape is approached, a similar photosensor generates a signal which can be used to start a second recorder. The sequential signal is also generated if power fails or tape breaks in the first recorder. The control logic also receives broken-tape or missing-tape signals from the vacuum system, and shuttle-control signals from an optional footage counter assembly when it is installed and in the shuttle mode.

REEL CONTROL

The tape reels are controlled by reel motors which mount on the back of the baseplate. The shafts of these motors project through holes in the baseplate. On the shafts are mounted reel holddowns that hold the reels while they are in use. Included in the reel servos is a vacuum chamber assembly which is divided into two sections each of which maintains a loop of tape. These loops are forced into the chamber by ambient air moving in to fill a vacuum which is generated by a blower in the vacuum housing assembly behind the transport.

Light sources and photosensors within the vacuum chamber sense the positions of the loops, and generate control signals that are used to adjust the position of the reel motors to keep the loop-lengths correct. This action results in servo control of tape tension in all modes of operation and in the tape being wound on and off the reels as required. The vacuum chamber also acts to isolate (buffer) the capstan/head area from tape-tension disturbances.

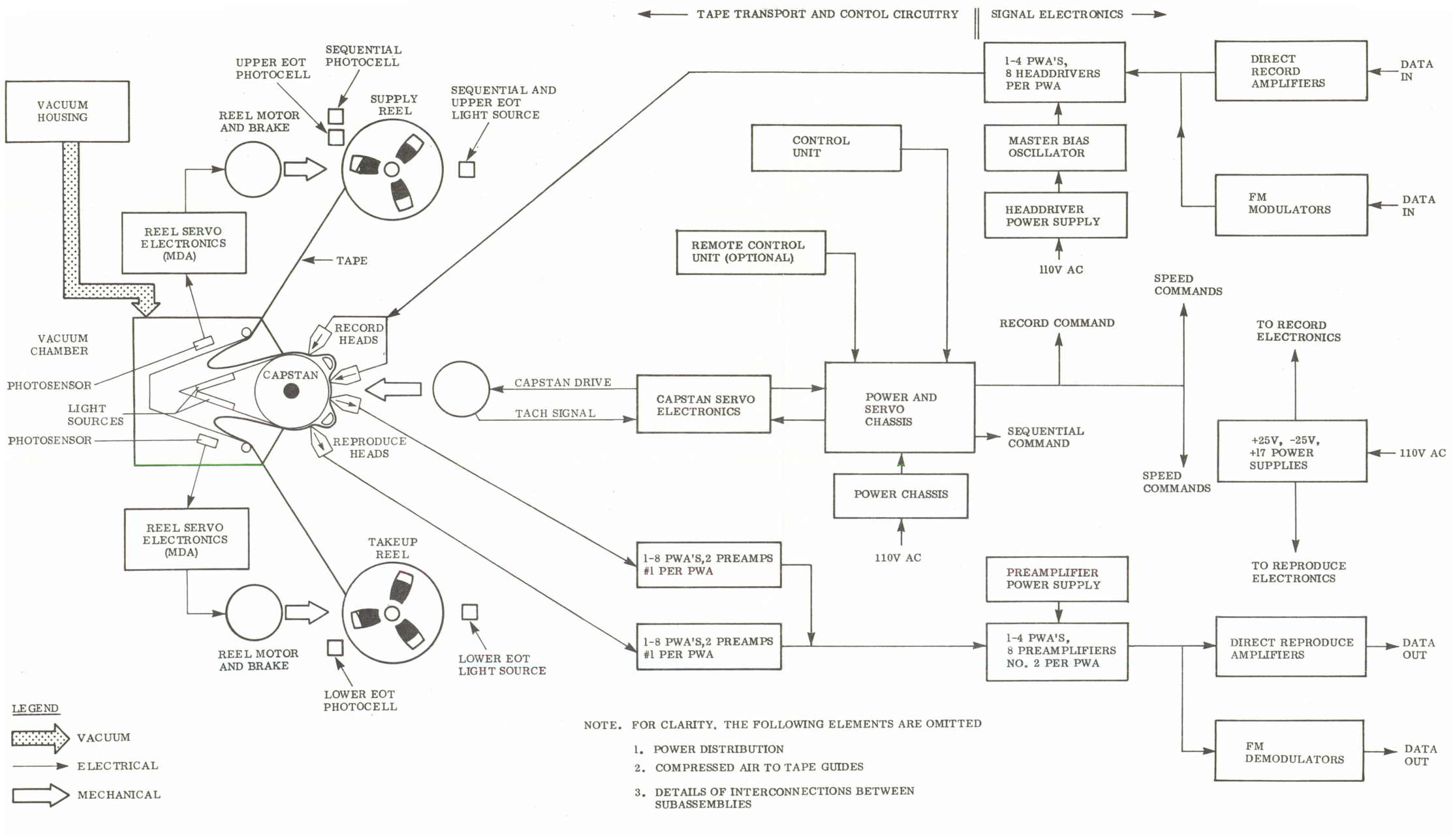


Figure 4-4. FR3010 System Block Diagram

CAPSTAN CONTROL

Reference Figures 4-5 and 4-6, the tape is moved, and therefore its speed is controlled, by a capstan. In operation, the tape is wrapped in contact with 110° of an elastomer-surfaced puck which is 1 foot in circumference. This gives the puck a non-slip grip on the tape. The puck is turned by a motor which is part of a closed-loop servo. The functioning of the servo is based on a crystal-oscillator reference signal. When tape is being moved, the reference signal is compared to a signal representing either capstan speed or tape speed. Differences between the reference signal and the comparison signal are used to form an error signal which controls power from the power and servo chassis to the motor. This results in a high degree of speed-error correction.

POWER SUPPLIES AND REGULATORS

Reference Figure 4-6, the power and servo chassis includes the power supplies and a power regulator assembly required for operation of the tape transport. The main power supply (a multiple output supply) provides power which drives the capstan and reel motors and releases the reel brakes.

±18V power from the main power supply is also processed by a ±12V regulator assembly which includes a +5V regulator section. This assembly provides the power to operate the logic circuits which control the transport. The ±12V regulator (as well as the logic circuits) are plug-in printed wiring assemblies (pwa's) which mount in the power and servo chassis.

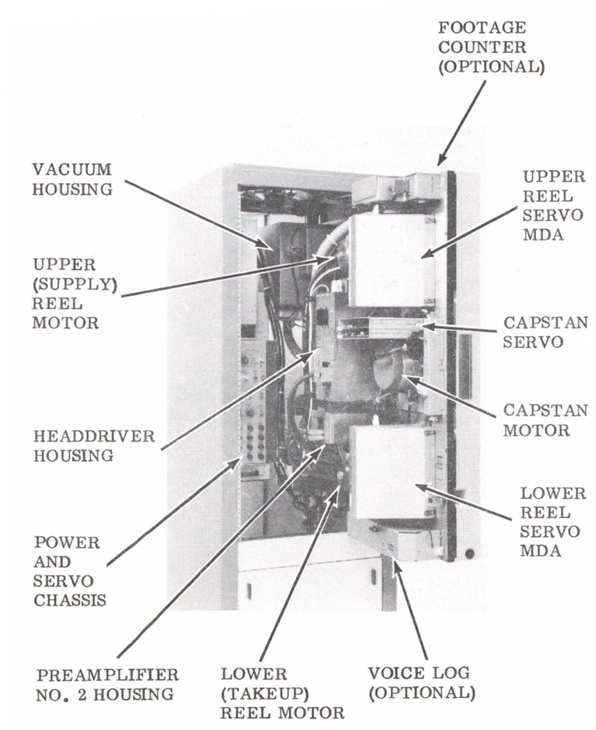


Figure 4-5. FR3010 Transport Interior Assemblies - Covers Closed

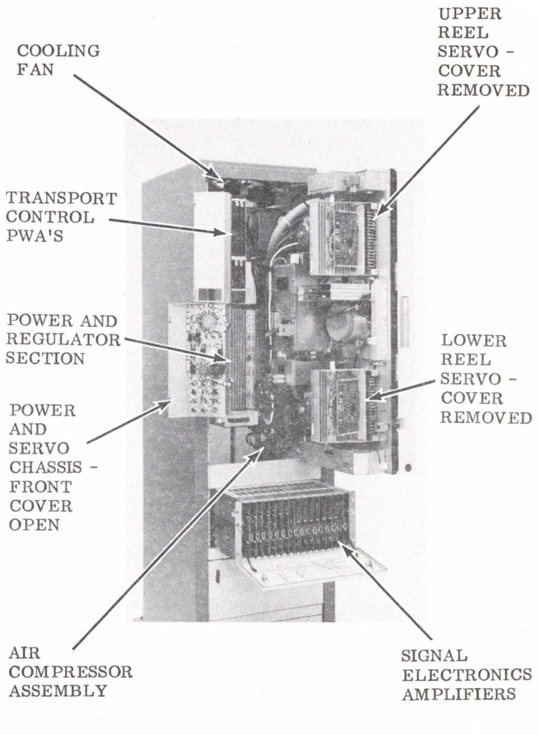


Figure 4-6. FR3010 Transport Interior Assemblies - Covers Open

SIGNAL ELECTRONICS

GENERAL

Reference Figure 4-7, the signal electronics must process the incoming data signals and convert them to such a form that they may be recorded on magnetic tape. Later upon demand it must be able to process the signals from the magnetic tape and reconvert them into the same form that they were originally presented to the recorder. In order to do this, five general categories of signal electronics are used.

a. Common Use Electronics. These items such as heads, bias source, headdrivers and preamplifiers are jointly used by the various types of signal amplifiers such as direct, FM, high density PCM, etc.

b. Trays, housings, fans and cables. These items normally include the housings into which common use electronics and data amplifiers are installed, the fans which cool them, and the power supplies which service them.

c. Power supplies and regulators. These items provide power and reference voltages for the individual signal electronics pwa's.

d. Direct Signal Electronics. These electronics produce head currents that are analogous to the frequency and amplitude of the incoming data signal. Upon reproduction, the direct reproduce amplifier amplifies and equalizes the signal from the reproduce head and provides an output which is analogous to the original input data ($E_{IN} = E_{OUT}$).

e. FM Signal Electronics. These electronics convert the data signal input into a frequency modulated carrier. This carrier, representative of the data amplitude and frequency, is converted in the reproduce amplifier back to the original data signal ($E_{IN} \rightarrow f_m = f_m \rightarrow E_{OUT}$).

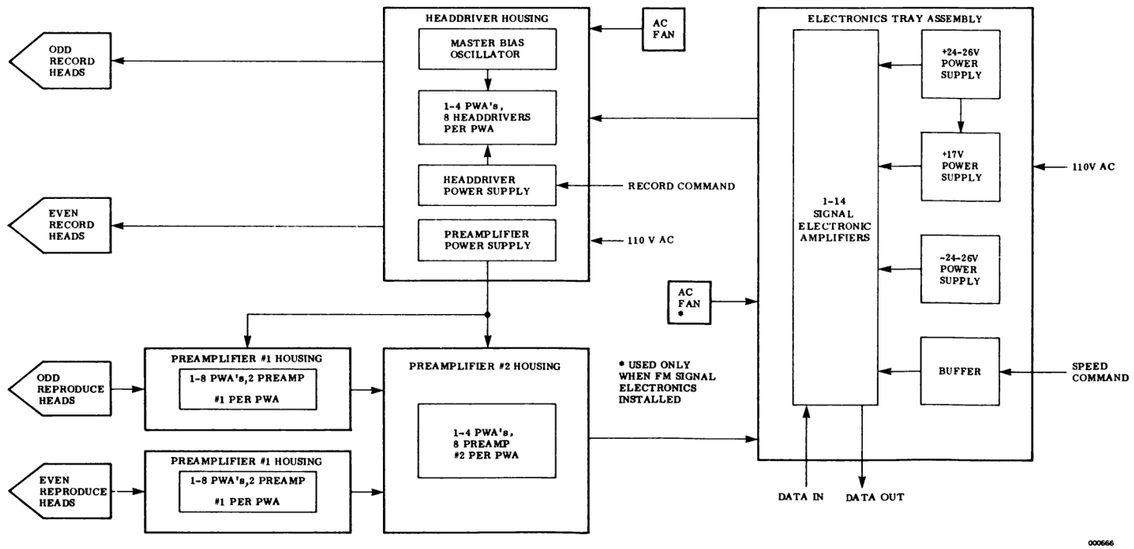


Figure 4-7. FR3010 Signal Electronics Block Diagram

COMMON USE ELECTRONICS

Reference Figures 4-7, 4-8, 4-9 and 4-10, those signal electronics assemblies that are used jointly by all types of data signal systems will be referred to as common use electronics. These items consist of:

a. Master bias oscillator

b. Headdriver assemblies

c. Preamplifier number 1

d. Preamplifier number 2

e. Record and reproduce heads

The master bias oscillator is part of the A2 assembly of the headdriver housing. It is a solid state, 7.7 MHz, Colpitts oscillator with 2 outputs that are 180° out of phase with each other. Each of these outputs is capable of driving two bias amplifiers which are part of the record headdriver assemblies. The bias is linearly mixed with the data signals in the headdriver printed wiring assemblies (pwa's).

Each record headdriver assembly contains two separate stages:

a. The first, commonly referred to as the bias amplifier, provides current amplification of the 7.7 MHz bias being fed to it from the bias oscillator. It provides sufficient bias current for the eight channels of amplifier/mixers that are mounted on the same printed wiring assembly.

b. The second stage consists of eight channels of amplifier/mixers. Each of these channels provide data signal current amplification, ac bias adjustment and linear bias and data signal mixing. It also provides dc bias for nulling out second harmonics and a monitor circuit for the 7.7 MHz bias.

The preamplifier also consists of two separate stages:

a. Preamplifiers number 1

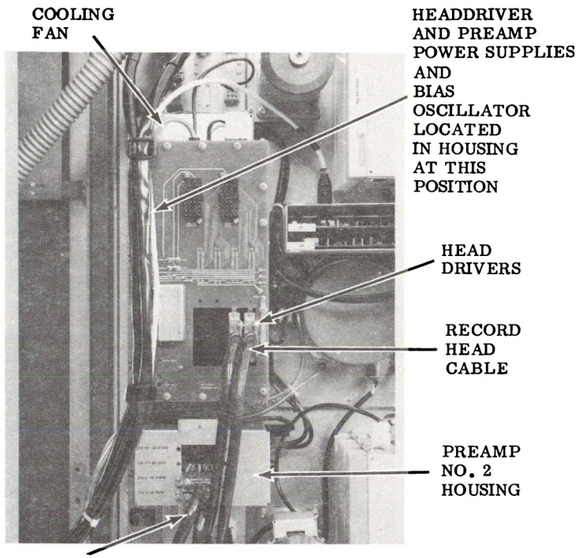


Figure 4-8. Headdriver and Bias Oscillator Assemblies - Location

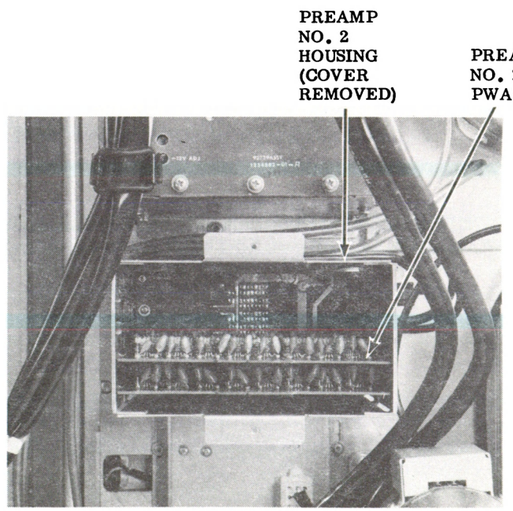


Figure 4-9. Preamplifier Number 2 PWA's

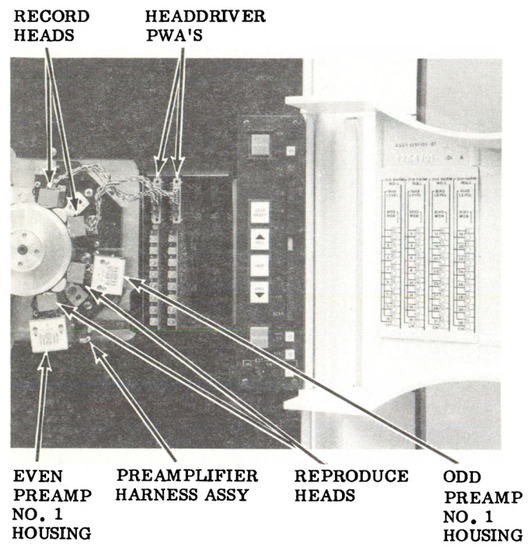


Figure 4-10. Headdrivers, Heads and Preamplifier No. 1's - Location

b. Preamplifiers number 2

Preamplifier number 1, mounted two channels per pwa, is located in a housing directly behind each reproduce headstack. It acts as a voltage to current converter and forms part of the total 40 dB gain preamplifier system with preamplifier number 2.

Preamplifier number 2, mounted eight channels per pwa, is mounted in the preamplifier number 2 housing at the rear of the transport baseplate. It converts the differential input from preamplifier number 1 to a single-ended output, filters out any bias feedthrough and drives the reproduce signal electronics pwa's.

The record and reproduce head assemblies are mounted on separate baseplates. Each assembly contains two headstacks (odd and even) and a halfmoon air guide. All of these items are mounted on the baseplate at the factory and MUST NOT BE MOVED in the field. The positioning of the air guides with respect to the heads, and the positioning of the heads with respect to the tape path are extremely critical. Lubricating air for the guide is supplied by a compressor that is mounted at the rear of the tape transport. Discussion of the air guide and air compressor will be found in the FR3000 Maintenance Manual 1802854.

TRAYS, HOUSINGS, FANS AND CABLES

The signal electronics is normally fitted with a single ac cooling fan. This is mounted on the top of the headdriver housing and is used primarily to cool the A1 power supply assembly. When fm signal electronics is used, however, an additional ac fan is fitted below each signal electronics tray assembly to cool the fm pwa's.

Each signal electronics tray assembly will hold up to 7 record and 7 reproduce signal electronic pwa's. In addition, there are two spare slots which are normally used to house calibrate pwa's.

The headdriver housing, which is mounted to the rear of the transport baseplate assembly, contains two assemblies, the A1 headdriver and preamplifier power supply assembly, and the A2 master bias oscillator and connector assembly. Connectors are provided in the A2 assembly for four 8 channel headdriver pwa's that slip into the housing from the front. Each headdriver pwa connects to the headdriver power supply via its own J1 connector. Each headdriver pwa has two additional connectors; at the front, J2 is connected to the record heads by the record head captive cable; at the rear, the headdriver is connected to the record signal electronic amplifiers (located in the electronics tray assembly) via connector P1 and record head cable 1802812.

Reference Figures 4-7, 4-8 and 4-10, there are two preamplifier housings; the preamplifier no. 1 housings which are located at the rear of the heads and form an integral part of the head assemblies, and the preamplifier no. 2 housing, which is mounted at the rear of the transport baseplate beneath the headdriver housing.

There is a preamplifier no. 1 housing on the back of each odd and each even reproduce headstack. The number of preamplifier no. 1's inserted into the housing is dependent on the number of channels in use, i.e., in a seven channel system each housing will be fitted with two 2 channel preamplifiers; in a 14 channel system each housing contains four 2 channel preamplifiers; and in a 28 channel system each housing will contain up to eight 2 channel preamplifiers.

The preamplifier no. 2 housing provides space for installation of up to four 8 channel preamplifier no. 2's.

Interconnection between preamplifiers no. 1 and no. 2 is provided by preamplifier harness assembly 1254608. Power for preamplifier no. 1 and no. 2 housings is supplied from the preamplifier power supply via a captive preamplifier power cable.

Interconnection between preamplifiers no. 2 and the reproduce signal electronic amplifiers (located in the electronics tray assembly) is provided via connector P1 and reproduce head cable 1802845.

POWER SUPPLIES AND REGULATORS

Reference Figure 4-7, the power supplies for the individual signal electronics printed wiring assemblies are contained in the electronics tray assembly and headdriver housing. Those power supplies in the electronics tray assembly provide power for up to 14 channels of record and reproduce signal electronics (7 + 7 of each). The power supplies in the headdriver housing will provide power for up to 32 channels of headdriver and preamplifier printed wiring assemblies.

The signal electronics tray assembly contains two 25V power supplies. These are located in the rear of the tray. One power supply provides +25V for the signal electronics printed wiring assemblies housed in the tray. It is also used as the primary source voltage for a +17V regulator which is used to provide the reference voltage when FM signal electronics is used. The +17V regulator is mounted adjacent to the +25V power supply at the rear of the electronics tray assembly. A second power supply provides -25V for up to 14 record or reproduce pwa's. Additionally the electronics tray assembly contains a buffer pwa that is used to convey transport speed information to the speed sensitive elements of the signal electronics (selects the correct equalizer, filter, or carrier frequency for the tape speed selected).

The power supplies contained in the headdriver housing are part of the same assembly, that is, the A1 headdriver and preamplifier power supply. One section provides power for up to 32 channels of headdrivers. In addition it provides +24V which may be used to energize head switching relays when they are used in the system. The second section of the power supply provides power for up to 32 channels of preamplifier no. 1's and no. 2's which are installed in their own separate housings.

DIRECT SIGNAL ELECTRONICS

The direct record amplifier provides broadband amplification of the input data signals while maintaining a flat frequency response. Its output signals are fed to a record headdriver where they are mixed with high frequency ac bias and used to drive the record head. In addition a monitor output is provided for metering purposes. See Figure 4-11 Direct Signal Electronics Block Diagram.

The direct reproduce amplifier equalizes the reproduce head output/frequency characteristics, provides phase correction, and amplifies the data signal from the preamplifiers to a nominal output. Seven equalizer stages are used (one for each of the tape speeds). Selection of the correct equalizer is made via speed switching circuits, which in turn get their command from the speed lines. The direct reproduce amplifier also provides a buffered monitor output.

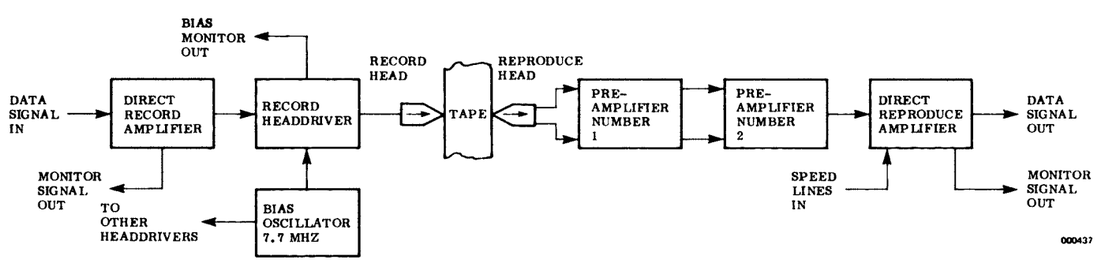


Figure 4-11. Direct Signal Electronics Block Diagram

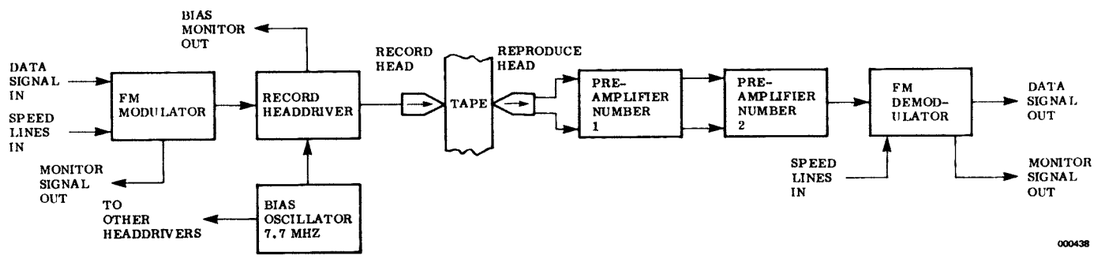


Figure 4-12. FM Signal Electronics Block Diagram

FM SIGNAL ELECTRONICS

Reference Figure 4-12, the fm modulator (record amplifier) provides a center carrier frequency, determined by bandwidth and tape speed selection which is linearly frequency modulated according to the amplitude and polarity of the data input. Maximum percent deviation of the center carrier frequency is determined by input signal amplitude. In simple approximation, the modulator may be regarded as a precision voltage-to-frequency converter and a frequency divider. The amount of frequency division is dependent upon the tape speed selected.

The fm modulator must be preprogrammed for input level attenuation and impedance matching, bandwidth range selection (WII, W, etc.), and carrier offset (unipolar, bipolar input, etc.). Details of this programming will be found in Section 3 of this manual.

The fm demodulator (reproduce amplifier) functions as a precision frequency-to-voltage converter. It provides a data signal output, the amplitude and polarity of which correspond to the linear, frequency modulation of the center carrier frequency (ccf) applied at the input.

In order to accommodate four bandwidths: Wideband II (WII), Wideband I (W), Intermediate Band (I), and Lowband (L), as defined by IRIG standards, the fm demodulator is equipped with equalizers, timing components and filters which are automatically selected according to tape speed selection. Some initial programming must be done, however, to select the individual range of operation, i.e., WII or W, etc. Refer to Section 3 of this manual for programming instructions. The modulator also contains a squelch circuit that inhibits the output when the carrier signal is lost or absent for a period of 20 milliseconds or more.

SECTION 5
RACKS, BAYS, FANS AND CABLES

SECTION 5

BAYS, HOUSINGS, FANS AND CABLES

TABLE OF CONTENTS

LIST OF ASSEMBLY DRAWINGS

INTERNATIONAL TRANSFORMER ASSEMBLY AND SCHEMATIC REFERENCE - 1802950-01

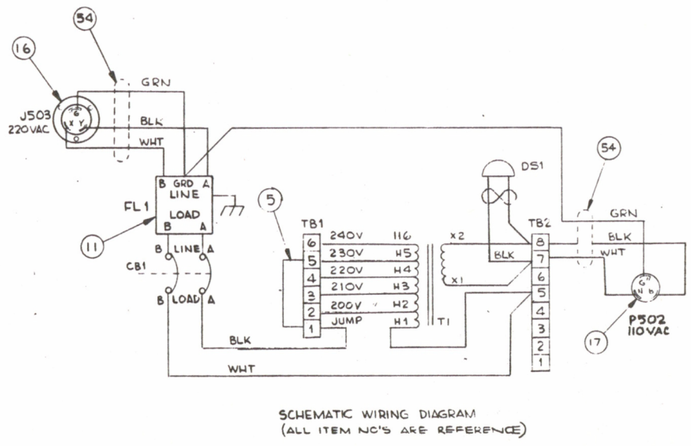
GENERAL

Racks, bays, fans, and cables, etc., which are not parts of the tape transport or signal electronics are covered in this section.

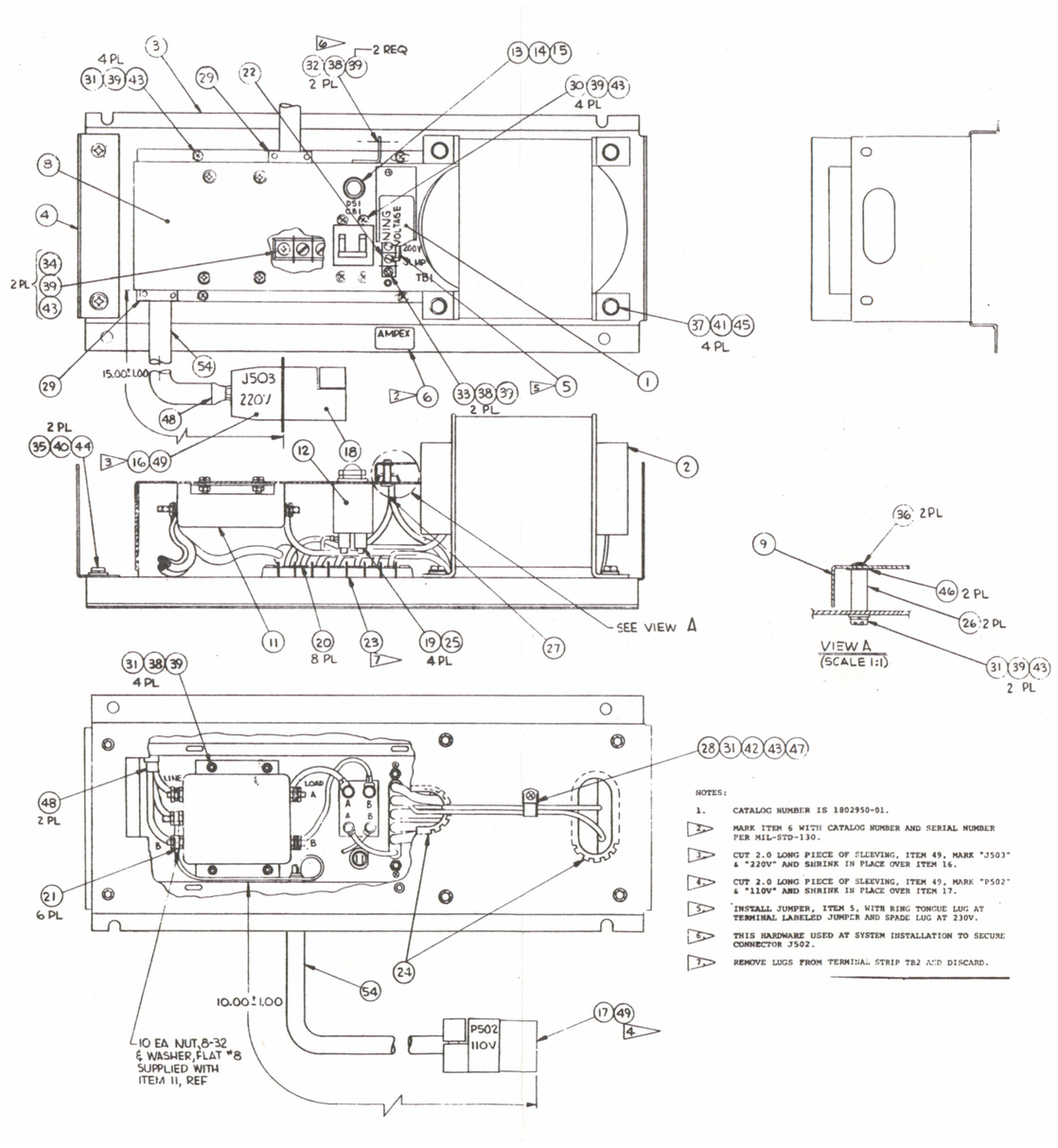
INTERNATIONAL TRANSFORMER ASSEMBLY 1802950

A 220 volt to 110 volt stepdown transformer must be used in areas supplied with 220 volt 50 hertz ac power.

Installation instructions for the International Transformer Assembly are contained in Drawing 1254759.



SCHEMATIC WIRING DIAGRAM
(ALL ITEM NO'S ARE REFERENCE)



NOTES:

1. CATALOG NUMBER IS 1802950-01.
2. MARK ITEM 6 WITH CATALOG NUMBER AND SERIAL NUMBER PER MIL-STD-130.
3. CUT 2.0 LONG PIECE OF SLEEVING, ITEM 49, MARK "J503" & "220V" AND SHRINK IN PLACE OVER ITEM 16.
4. CUT 2.0 LONG PIECE OF SLEEVING, ITEM 49, MARK "P502" & "110V" AND SHRINK IN PLACE OVER ITEM 17.
5. INSTALL JUMPER, ITEM 5, WITH RING TONGUE LUG AT TERMINAL LABELED JUMPER AND SPADE LUG AT 230V.
6. THIS HARDWARE USED AT SYSTEM INSTALLATION TO SECURE CONNECTOR J502.
7. REMOVE LUGS FROM TERMINAL STRIP TB2 AND DISCARD.

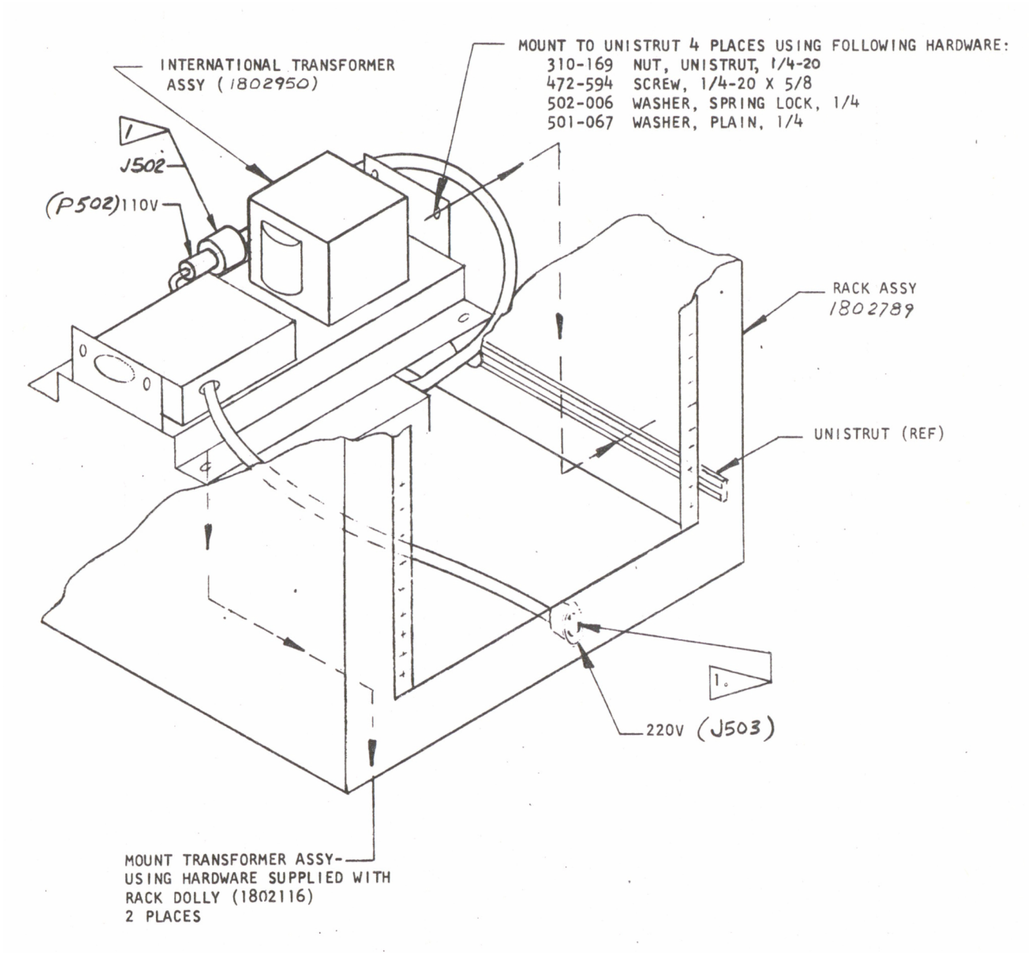
LIST OF MATERIALS 1802950

ITEM NO.	AMPEX PART NO.	SCHEMATIC REFERENCE	PART DESCRIPTION	QTY PER UNIT -01		
1	1213679-01		Label, voltage warning	1		
2	1245882-01	T1	Transformer	1		
3	1249873-01		Chassis	1		
4	1249874-01		Bracket	1		
5	1250115-01		Jumper	1		
6	1251522-01		Label, ident	1		
7	1254759		Install instr: intl xmfr	ref		
8	1255237-01		Top chassis	1		
9	1255238-01		Cover, term board	1		
11	052-211	FL1	Filter, rf interface	1		
12	126-120	CB1	Circuit breaker, 250V ac, 15A	1		
13	132-123		Lens, indicator light	1		
14	132-124		Socket, indicator light	1		
15	132-125	DS1	Light fixture, indicator	1		
16	145-636	J503	Connector, pwr recpt, male cont	1		
17	145-637	P502	Connector, pwr plug, fem cont	1		
18	145-638	P503	Connector, pwr plug, fem cont	1		
19	171-007		Terminal lug, crimp, ring tongue #10	4		
20	172-211		Terminal lug, crimp, spade tongue #8	8		
21	172-218		Terminal lug, crimp, ring tongue #8	6		
22	180-777	TB1	Terminal strip, 6 term	1		
23	185-162	TB2	Terminal strip, 8 term	1		
24	260-062		Grommet, nylon, caterpillar	a/r		
25	267-023		Insulator cap, binding port	4		
26	280-040		Spacer, threaded, 6-32 x .750 lg	2		
27	296-004		Cord, lacing, blk	a/r		
28	302-075		Clamp, cable, .312 i.d.	1		
29	302-104		Clamp, cable, conn	2		
30	471-067		Screw, pan hd, xrec 6-32 x .250 lg	4		
31	471-069		Screw, pan hd, xrec 6-32 x .375 lg	11		
32	471-070		Screw, pan hd, xrec 6-32 x .438 lg	2		
33	471-072		Screw, pan hd, xrec 6-32 x .625 lg	2		
34	471-073		Screw, pan hd, xrec 6-32 x .750 lg	2		
35	471-098		Screw, pan hd, xrec 1/4-20 x .750 lg	2		
36	471-606		Screw, truss hd, xrec 6-32 x .250 lg	2		
37	480-084		Bolt, hex hd, 5/16-18 x .750 lg	4		
38	496-005		Nut, hex, captive washer, 6-32	8		
39	501-009		Washer, plain, #6	22		
40	501-012		Washer, plain, 1/4	2		
41	502-022		Washer, plain, 5/16	4		
42	501-188		Washer, plain, #6 sm patt	1		
43	502-003		Washer, spring lock #6	13		
44	502-006		Washer, spring lock 1/4	2		
45	502-105		Washer, spring lock 5/16	4		
46	503-316		Washer, flat, fiber #5	2		
47	506-013		Washer, D-140	1		
48	600-097		Sleeving, shrink, .750/.375 i.d.	a/r		
49	600-117		Sleeving, shrink, 2.0/1.0 i.d.	a/r		
50	611-158		Wire, str, ins, #14 AWG, blk	a/r		
51	611-160		Wire, str, ins, #14 AWG, wht	a/r		
52	611-162		Wire, str, ins, #16 AWG, blk	a/r		
53	611-498		Wire, str, ins, #14 AWG, grn	a/r		
54	616-032		Cable, 3 cond, #14 AWG	a/r		
			Item not used: 10			

WIRE LEAD LIST 1802950

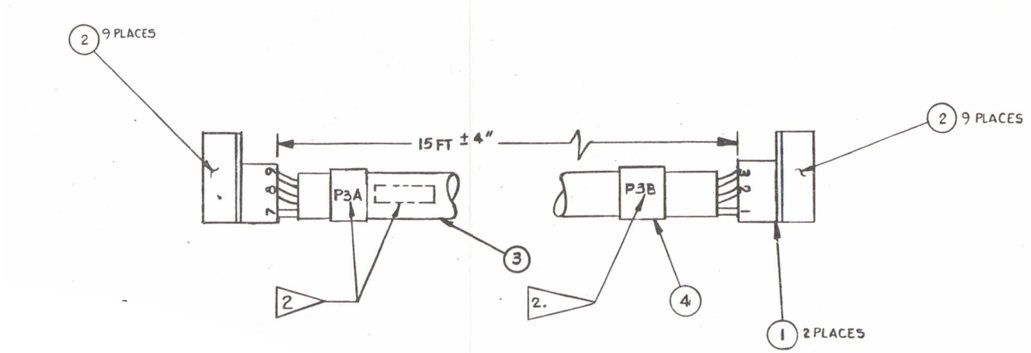
WIRE NO.	AWG/ COLOR	FROM REF DES	FROM TERM	TO REF DES	TO TERM	REMARKS	LM ITEM NO. -01		
1		T1	X1	TB2	7	Component lead item 2			
2			X2	TB2	8				
3			H1	TB2	5				
4			H2	TB1	2				
5			H3		3				
6			H4		4				
7			H5		5				
8		T1	H6		6	Component lead item 2			
9		TB1	1	TB1	5	Component lead item 5			
10	14/0	J503	X	FL1 (line)	A				
11	14/9	J503	Y		B		54		
12	14/5	J503	G		GRD				
13	14/5	P502	G	FL1 (line)	GRD				
14	14/9	P502	N	TB2	7		54		
15	14/0	P502	B	TB2	8				
16	14/0	CB1 (line)	A	FL1 (load)	A		50		
17	14/9	CB1 (line)	B	FL1 (load)	B		51		
18	14/0	CB1 (load)	A	TB1	1		50		
19	14/9	CB1 (load)	B	TB2	5		51		
20	16/0	DS1	-	TB2	7	Twisted pair	52		
21	16/0	DS1	-	TB2	8		52		

INSTALLATION INSTRUCTIONS 1254759 FOR INTERNATIONAL TRANSFORMER ASSEMBLY 1802950



1. REMOVE 110V POWER INPUT RECEPTACLE FROM REAR PANEL OF RACK ASSY. AND MOUNT ON BRACKET PROVIDED ON TRANSFORMER ASSY. MOUNT 220V POWER INPUT RECEPTACLE OF TRANSFORMER ASSY ON RACK ASSY REAR PANEL.

SEQUENTIAL CONTROL CABLE ASSEMBLY 1802203-02B



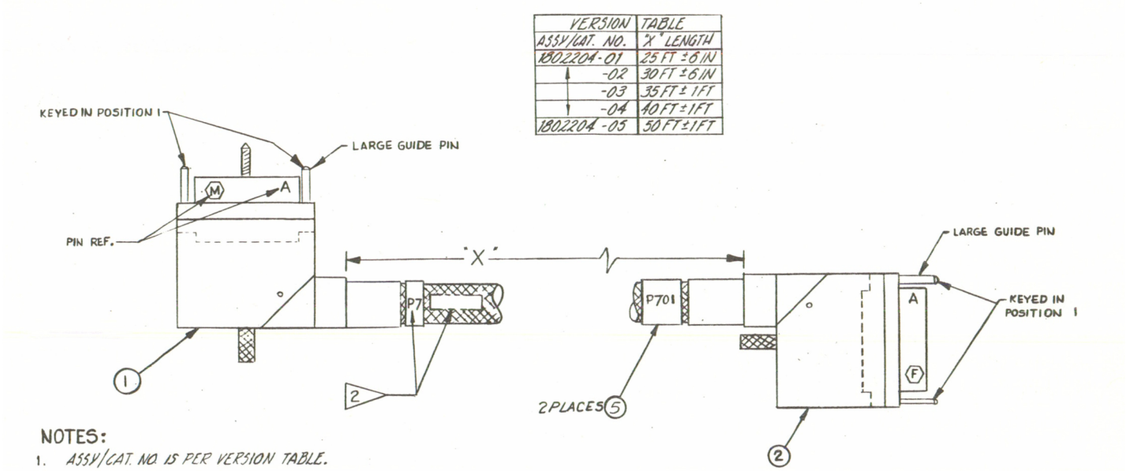
NOTES:
1. ASSY/CAT. NO. IS 1802203-02.
2. MARK ASSY/CAT. NO. & REF DESIG APPROX WHERE SHOWN PER MIL-STD-130.

LIST OF MATERIALS 1802203

ITEM NO.	AMPEX PART NO.	SCHEMATIC REFERENCE	PART DESCRIPTION	QTY PER UNIT -02		
1	169-146	P3A,3B	Connector, rect recp, 9 cont	2		
2	169-993		Contact, hermaphrodite, use w/169-146	18		
3	600-043		Sleeving, plastic, blk, .330 i.d.	a/r		
4	600-095		Sleeving, shrinkable, blk, .500 i.d.	a/r		
5	611-209		Wire, strd, insl, #24 AWG, brn	a/r		
6	611-210		Wire, strd, insl, #24 AWG, gy	a/r		
7	611-268		Wire, strd, insl, #24 AWG, red	a/r		
8	611-347		Wire, strd, insl, #24 AWG, blu	a/r		
9	611-348		Wire, strd, insl, #24 AWG, yel	a/r		
10	611-427		Wire, strd, insl, #24 AWG, wht	a/r		
11	611-428		Wire, strd, insl, #24 AWG, grn	a/r		
12	611-429		Wire, strd, insl, #24 AWG, orn	a/r		
13	611-503		Wire, strd, insl, #24 AWG, vio	a/r		

WIRE LEAD LIST 1802203

WIRE NO.	AWG/ COLOR	FROM REF DES	FROM TERM	TO REF DES	TO TERM	REMARKS	LM ITEM NO. -02		
1	24/1	P3A	1	P3B	1		5		
2	24/2	P3A	2	P3B	2		-		
3	24/3	P3A	3	P3B	3		12		
4	24/4	P3A	4	P3B	4		-		
5	24/5	P3A	5	P3B	5		11		
6	24/6	P3A	6	P3B	6		8		
7	24/7	P3A	7	P3B	7		13		
8	24/8	P3A	8	P3B	8		6		
9	24/9	P3A	9	P3B	9		10		
10	24/2	P3A	2	P3B	4		7		
11	24/4	P3A	4	P3B	2		9		



VERSION TABLE	
ASSY/CAT. NO.	"X" LENGTH
1802204-01	25 FT ±6 IN
-02	30 FT ±6 IN
-03	35 FT ± 1 FT
-04	40 FT ± 1 FT
1802204-05	50 FT ± 1 FT

NOTES:

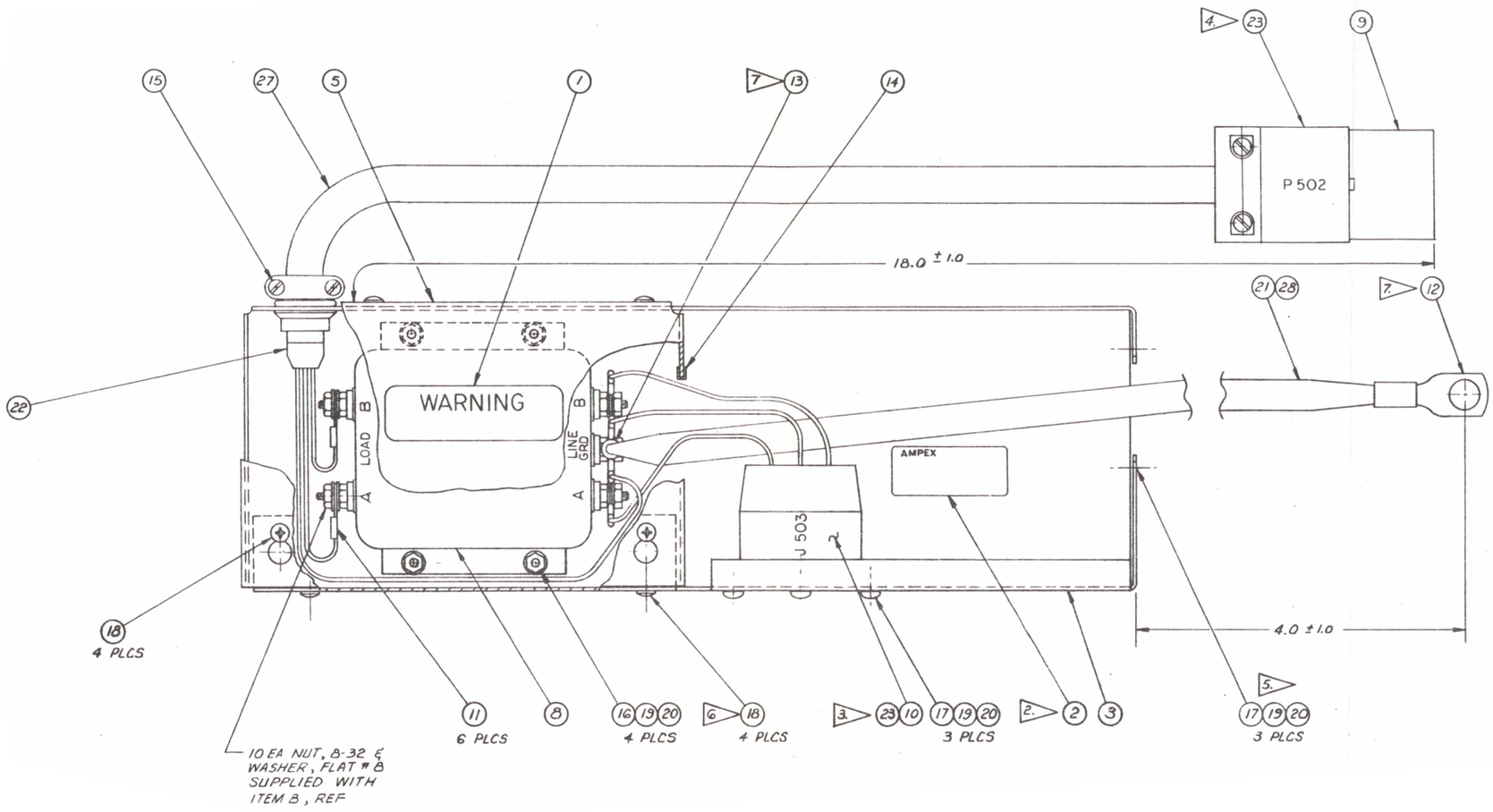
1. ASSY/CAT. NO IS PER VERSION TABLE.
2. MARK ASSY/CAT. NO. & REF. DESIGNATIONS APPROX WHERE SHOWN PER MIL-STD-130.
3. CUT BACK BOTH ENDS 3 UNUSED WIRES.

LIST OF MATERIALS 1802204

ITEM NO.	AMPEX PART NO.	SCHEMATIC REFERENCE	PART DESCRIPTION	QTY PER UNIT -01	-02	-03	-04	-05
1	166-036	P7	Body, rect, plug, 38 pos, female	1	1	1	1	1
2	166-045	P701	Body, rect, plug, 38 pos, male	1	1	1	1	1
3	169-872		Contact, hermaphrodite	76	76	76	76	76
4	616-434		Cable, insulated, 41 conductors	a/r	a/r	a/r	a/r	a/r
5	600-095		Sleeving, plastic, shrinkable, .500 i.d. (black)	a/r	a/r	a/r	a/r	a/r

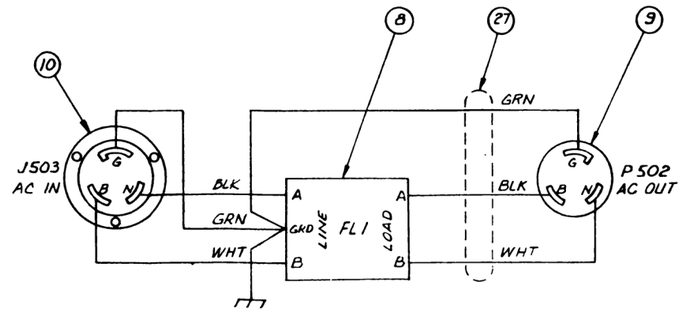
WIRE LEAD LIST 1802204

WIRE NO.	AWG/ COLOR	FROM REF DES	FROM TERM	TO REF DES	TO TERM	REMARKS	LM ITEM NO. -01 thru -05
1	20/0	P7	A	P701	A		6
2	/1		B		B		
3	/2		C		C		
4	/3		D		D		
5	/4		E		E		
6	/5		F		F		
7	/6		H		H		
8	/7		J		J		
9	/8		K		K		
10	/9		L		L		
11	/90		M		M		
12	/91		N		N		
13	/92		P		P		
14	/93		R		R		
15	/94		S		S		
16	/95		T		T		
17	/96		U		U		
18	/901		V		V		
19	/97		W		W		
20	/98		X		X		
21	/902		Y		Y		
22	/903		Z		Z		
23	/904		AA		AA		
24	/905		BB		BB		
25	/906		CC		CC		
26	/907		DD		DD		
27	/908		EE		EE		
28	/912		FF		FF		
29	/913		HH		HH		
30	/914		JJ		JJ		
31	/915		KK		KK		
32	/916		LL		LL		
33	/917		MM		MM		
34	/918		NN		NN		
35	/923		PP		PP		
36	/924		RR		RR		
37	/925		SS		SS		
38	20/926	P7	TT	P701	TT		6



NOTES:

1. CATALOG NUMBER IS 1802939-01.
2. MARK ITEM 2 WITH CATALOG NUMBER AND SERIAL NUMBER PER MIL-STD-130.
3. CUT 2.0 LONG PIECE OF SLEEVING, ITEM 23, MARK "J503" AND SHRINK IN PLACE OVER ITEM 10.
4. CUT 2.0 LONG PIECE OF SLEEVING, ITEM 23, MARK "P502" AND SHRINK IN PLACE OVER ITEM 9.
5. THIS HARDWARE USED AT SYSTEM INSTALLATION TO SECURE CONNECTOR J502.
6. THIS HARDWARE USED AT INSTALLATION.
7. CRIMP AND SOLDER-FILL TERMINAL LUGS (ITEMS 12 & 13). INSULATING SLEEVE MAY BE REMOVED.



SCHEMATIC WIRING DIAGRAM
(ALL ITEM NO'S ARE REF)

LIST OF MATERIALS 1802939

ITEM NO.	AMPEX PART NO.	SCHEMATIC REFERENCE	PART DESCRIPTION	QTY PER UNIT -01		
1	1213679-01		Label, voltage warning	1		
2	1251522-01		Label, identification	1		
3	1255244-01		Chassis	1		
4	1255245		Installation instructions	ref		
5	1255251-01		Cover	1		
8	052-211	FL1	Filter, rf interface	1		
9	145-637	P502	Connector, pwr, plug, fem cont	1		
10	145-640	J503	Connector, pwr, recpt, male cont	1		
11	172-218		Terminal lug, crimp, ring tongue #8 stud	6		
12	172-255		Terminal lug, crimp, ring tongue 1/2 i.d.	1		
13	172-279		Terminal lug, crimp, ring tongue #10 stud	1		
14	260-062		Grommet, nylon, caterpillar	a/r		
15	302-104		Clamp, cable conn	1		
16	471-069		Screw, pan hd, xrec, 6-32 x .375 lg	4		
17	471-070		Screw, pan hd, xrec, 6-32 x .438 lg	6		
18	471-606		Screw, truss hd, xrec, 6-32 x .250 lg	8		
19	496-005		Nut, hex, captive washer, 6-32	10		
20	501-009		Washer, plain #6	10		
21	600-095		Sleeving, shrink, .500/.250 i.d.	a/r		
22	600-097		Sleeving, shrink, .750/.375 i.d.	a/r		
23	600-117		Sleeving, shrink, 2.0/1.0 i.d.	a/r		
24	611-158		Wire, str, ins, #14 AWG, blk	a/r		
25	611-160		Wire, str, ins, #14 AWG, wht	a/r		
26	611-498		Wire, str, ins, #14 AWG, grn	a/r		
27	616-032		Cable, 3 cond, #14 AWG	a/r		
28	615-029		Wire, braid, tubular .375 i.d.	a/r		
			Items not used: 6,7			

WIRE LEAD LIST 1802939

WIRE NO.	AWG/ COLOR	FROM REF DES	FROM TERM	TO REF DES	TO TERM	REMARKS	LM ITEM NO. -01
1	14/0	J503	B	FL1 Line	A		24
2	14/9	J503	N		B		25
3	14/5	J503	G		GRD		26
4	BRAID				GRD	Grounding Strap	28
5	14/5	P502	G	Line	GRD		
6	14/0	P502	B	Load	A		27
7	14/9	P502	N	FL1 Load	B		

SECTION 6
PREVENTIVE MAINTENANCE

SECTION 6

PREVENTIVE MAINTENANCE

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SECTION 6
PREVENTIVE MAINTENANCE

GENERAL

Preventive maintenance is intended to maintain a high operational standard and minimize corrective maintenance by means of suitable routine inspection, cleaning, etc., at suitable intervals.

TOOLS AND MATERIALS REQUIRED

The tools and materials required to perform preventive maintenance in this section are listed in Table 6-1.

Table 6-1. Tools or Material Required

Tool or Material	Identification or Type
Head Cleaner	Ampex 050-104
Toothbrush	Any ordinary soft toothbrush
Clean, lint-free cloth	- - -
Cotton Swab	Ampex 650-080 or equivalent
Alcohol	Denatured ethyl or isopropyl
Head Degausser	Ampex HD-16 (1815050-01)
Vacuum Cleaner	Any ordinary

MAINTENANCE SCHEDULE

Depending upon the type and quantity of tape used or total operating time, the amount of cleaning required will vary. Additionally when a tape transport is operated in a dusty environment, greater frequency of cleaning should be done. Normally alignment of signal electronics including degaussing of the heads should only be done after a series of preformance checks have been made and the result indicated the need for degaussing or alignment.

Each time the tape is threaded the surface of the heads, capstan and guides should be examined for oxide or dust deposits. A sudden drop off of high frequency response or an increase in signal dropouts is a good indication that the heads are dirty and need cleaning. A loss of high frequency response or an increase in second harmonic distortion may also be an indication that the heads need degaussing. Table 6-2 lists the recommended preventive maintenance tasks and their frequency.

Table 6-2. Maintenance Schedule

Task	Frequency of Performance
Transport Cleaning	Preceding each data recording
Capstan Cleaning	Preceding each data recording
Capstan Cleaner	As necessary when it becomes dirty
Head	Preceding each pass of a full reel of tape during recording or when loss of signal occurs during reproduction.
Head Degaussing	When the performance checks or adjustment procedures indicate the necessity.
Halfmoon Guide Cleaning	As necessary when it becomes dirty
Vacuum Chamber and Tape Guide Cleaning	As necessary when it becomes dirty. Generally speaking it is recommended that these items are checked preceding each data recording and cleaned if found to be dirty.
Vacuum Plenum Chamber Filter Cleaning	Semiannually or when it becomes dirty. When tape that has heavy shed problems is used, the vacuum plenum chamber filter will become dirty in a short period of time.
Air Compressor Filter Cleaning	Semiannually or when it becomes dirty.

CAUTION

USE ONLY APPROVED HEAD CLEANER AMPEX PART NUMBER 050-104 WHEN CLEANING HEADS.

HEAD RETRACTION AND REPLACEMENT

Referring to Figure 6-1, three cross recessed head baseplate mounting screws hold each head assembly to the precision plate. The two outer screws (captive #6-32) hold the head baseplate to the precision plate. The center cross recessed retaining screw (captive #10-32) screws into a retaining nut which fits into a slot in the precision plate. When this retaining screw is loosened, the head assembly may be slid to the right (away from the capstan) for either cleaning of the capstan or cleaning and/or degaussing the heads. Extreme care must be taken that the retaining screw is loosened no more than necessary to permit the assembly to slide away from the capstan (no more than one turn since it is screwed into its retaining nut by approximately three turns). Loosening the screw by more than one turn may cause it to pull free from its retaining nut and permit the head assembly to fall free from the precision plate and be damaged. To retract the head proceed as follows:

a. Unscrew the two outer captive head baseplate mounting screws from the precision plate.

b. While holding the head assembly with one hand loosen the large cross-recessed retaining screw one turn (located directly behind the halfmoon guide assembly) and slide the whole head assembly to the right. This will provide easy access to the capstan or head surfaces for cleaning

c. Tighten the retaining screw to keep the head from moving.

d. Repeat steps a, b and c for other head assembly.

To replace the heads after retraction, proceed as follows:

a. Holding the head assembly with one hand loosen the #10-32 captive cross-recessed center screw one turn and slide the head assembly left until its reference surfaces are in contact with the capstan housing.

b. While holding the head assembly in position, secure the two outer #6-32 cross-recessed head baseplate mounting screws into the transport precision plate.

c. Tighten down the #10-32 center cross-recessed retaining screw.

d. Repeat steps a through c for other head assembly.

CLEANING

TRANSPORT

Clean all dust and loose foreign material from the transport. A clean-lint free cloth dipped into alcohol may be used for this purpose. Use a vacuum cleaner to remove dust from otherwise inaccessible areas. Do not blow air into the transport; it may cause dust to be blown into the bearings, etc.

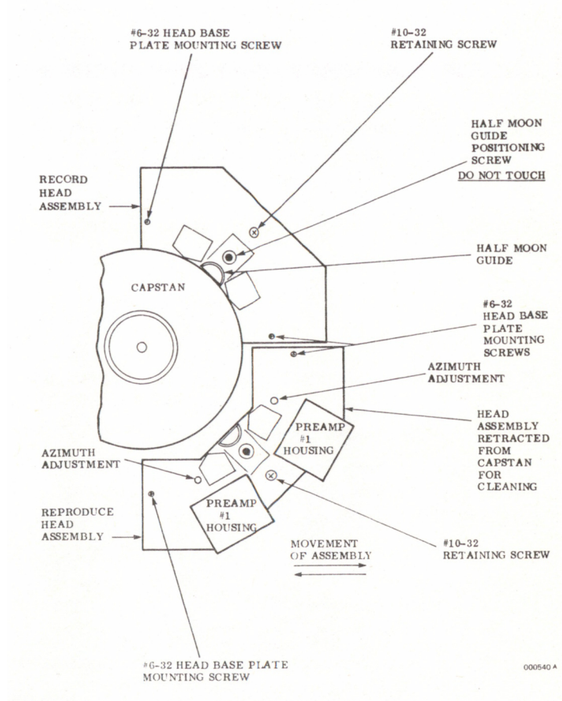


Figure 6-1. Head Retraction for Cleaning and Degaussing

CAPSTAN

To clean the capstan proceed as follows:

a. Retract the head assemblies as indicated above.

b. Clean the capstan puck with a lint-free cloth or cotton swab lightly moistened with isopropyl or denatured ethyl alcohol. This can be done by holding the cloth or swab against the capstan surface while turning the capstan slowly by hand. Remove all traces of foreign matter. Pay particular attention to cleaning the grooves in the elastomer surface of the capstan puck. This can be accomplished by lightly brushing the capstan surface with a very fine nylon or bristle brush (toothbrush). (Bristles should not be so hard as to damage the elastomer surface). Care should be taken to prevent the isopropyl or denatured ethyl alcohol from entering the area behind the capstan puck. Excessive moisture in this area could damage the optics assembly located there.

c. Proceed to capstan cleaner assembly maintenance.

CAPSTAN CLEANER ASSEMBLY

To clean the two foam pads of the capstan cleaner, remove the cleaner from the transport as follows:

a. Unscrew the 3-32 hex, socket-head screw from the capstan cleaner assembly.

b. Remove assembly by pulling it straight out from the capstan

c. Remove the polyurethane pads from the cleaner assembly (they slide out).

d. Clean the polyurethane pads by blowing compressed air through them or scrapping them lightly with a business card or finger nail. Dry thoroughly. If any of these methods does not completely clean the pads, they should be replaced with new pads (Ampex Part No. 1255009-01).

e. Replace the polyurethane pads in the capstan cleaner assembly.

f. Carefully replace the cleaner assembly in its original location. Care must be taken not to damage either of the vacuum chamber lamp holder assemblies (pwa) or the capstan surface.

g. Replace the socket head screw. Do not tighten.

h. Place a business card or two sheets of bond paper (approximately 0.005 inches total thickness) between the capstan cleaner assembly and the capstan. Holding the cleaner assembly against the capstan (with the business card in between) tighten down the socket head screw.

i. Slowly rotate the capstan to remove the card or paper. The cleaner assembly should be parallel to the surface of the capstan and separated from it by 0.005 inches. Only the polyurethane foam pads will be in contact with the capstan surface. Proceed with head cleaning and degaussing while the heads are still retracted from the capstan.

HEAD DEGAUSSING

If the head assemblies have not been previously retracted, do so by following the procedures under head retraction and replacement, and proceed with the degaussing as indicated below. If the heads are retracted proceed with the degaussing as indicated below:

a. Turn off the transport power.

b. Remove all tape from the transport and the immediate vicinity (at least three feet from any point at which the degausser will be held while it is energized).

c. Connect an Ampex Model HD-16 degausser (1815050-01) to a 117V ac 50/60 Hz power supply convenient to the transport. Do not connect or disconnect the degausser within three feet of the transport or tape. Degausser Ampex Model HD-16 Part No. 1815050-04 is used for 400 Hz power.

CAUTION

KEEP THE DEGAUSSER AT LEAST THREE FEET FROM THE HEAD ASSEMBLY AND OTHER TAPE HANDLING COMPONENTS BEFORE CONNECTING IT TO THE POWER SOURCE. THE INITIAL SURGE OF CURRENT WILL PRODUCE A STRONG FIELD THAT CAN MAGNETIZE THE ASSEMBLIES. KEEP THE DEGAUSSER WELL AWAY FROM ALL MAGNETIC TAPE THROUGHOUT THE PROCEDURE. DISCONNECTING THE DEGAUSSER FROM THE POWER SOURCE ALSO CREATES A STRONG MAGNETIC FIELD.

d. Carefully place the degausser pole tips in light contact with the head. Keep the pole tips parallel to the head surface (see Figure 6-2 and move the degausser slowly and steadily all the way inward along the head center line (this should take approximately 15 seconds). Reverse the direction of the degausser movement and bring it slowly and steadily outward along the center line. Continue outward motion until the degausser is well away from the heads. Quick or jerky motions with the degausser will gauss the heads.

e. Reapeat the procedures with the other head stacks.

f. After degaussing, the heads should be cleaned and returned to their operating position using the procedures listed under head retraction and replacement.

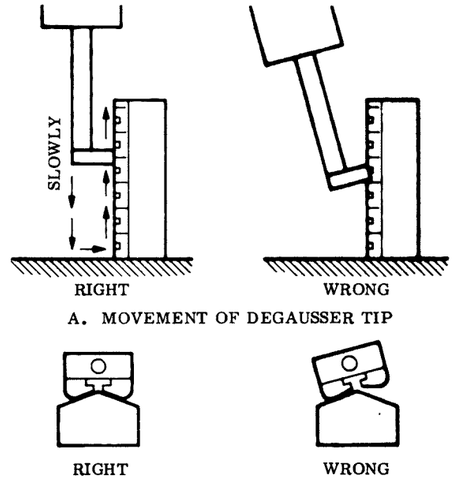


Figure 6-2. Head Degaussing

HEAD CLEANING

The head assemblies should have been retracted during the capstan and capstan cleaner cleaning procedures. If they are not, follow the procedures listed under head retraction and replacement above. To clean the heads proceed as follows:

CAUTION

USE ONLY APPROVED HEAD CLEANER AMPEX PART NO. 050-104. OTHER CHEMICALS OR SOLVENTS MAY DAMAGE THE HEAD ASSEMBLIES.

a. Moisten a cotton-tipped swab with approved head cleaner and carefully wipe the heads (with a scrubbing motion) so that all oxide, lubricant, and foreign matters are removed.

b. Repeat the scrubbing action with a clean swab for final cleaning.

c. Return the heads to their operational position following the procedures under Head Retraction and Replacement.

HALFMOON GUIDE CLEANING

To clean the halfmoon air guide (see Figure 6-1 for location), proceed as follows:

a. Using a lint-free cloth or cotton-tipped swab moistened in head cleaner, Ampex Part No. 050-104, clean the exposed surfaces of the air guide with an up and down scrubbing motion. Pay particular attention to the air slots.

b. Repeat the scrubbing action with a clean cloth or swab for final cleaning. All traces of tape oxide must be removed.

VACUUM CHAMBER AND TAPE GUIDE CLEANING

To clean the vacuum chamber and tape guides, clean as follows:

a. Open the vacuum chamber cover to gain access to the chambers.

b. Moisten a lint-free cloth or cotton-tipped swab in denatured alcohol. Clean the tape guide and rollers, the interior of the vacuum chamber, including the glass surfaces, and the inside of the cover. Be sure to remove all dirt and oxide. Use care not to let the alcohol get into the ball bearings of the outer roller guides.

c. When all surfaces are completely dry, close the vacuum chamber cover.

VACUUM PLENUM CHAMBER FILTER CLEANING

Refer to Figure 6-2. To clean the vacuum plenum chamber filter, proceed as follows:

a. Turn off transport power.

b. Disconnect the flexible vacuum hose from the underside of the vacuum plenum assembly.

c. Remove the 4 cross-recessed head screws from the corners of the vacuum plenum chamber while holding the plenum assembly in place.

d. Carefully allow the vacuum plenum assembly, with its captive cable, to drop down from the enclosure assembly far enough to gain access to the plenum area. Remove the coarse core polyurethane filter (1-3/4 inch thick, triangular-shaped pad located in the section of the plenum that contains the air shutter). Loosely secure the vacuum plenum assembly to the enclosure assembly.

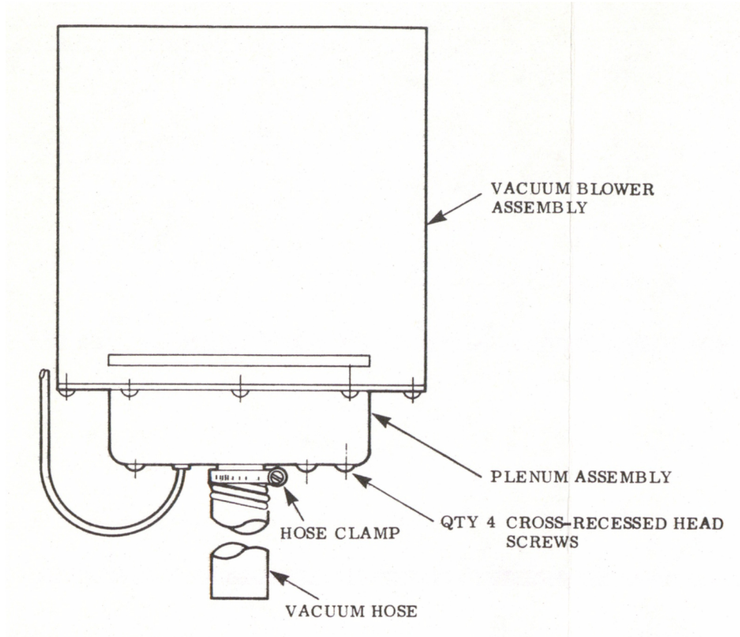
e. Clean the polyurethane filter by blowing compressed air through it or by washing it in alcohol or lukewarm water. Dry thoroughly.

f. Carefully (so as not to strain the captive cable connection) drop the vacuum plenum down enough to allow the replacement of the filter into the plenum assembly. Secure the plenum assembly to the vacuum blower enclosure assembly.

g. If replacement of the filter is desired, use Scott 1-3/4 inch thick polyurethane foam 20 ppl or Ampex part number 922-418 and cut to shape of old filter.

AIR COMPRESSOR FILTER CLEANING

The air compressor is fitted with an intake air filter, Thomas part number 641007. This filter should be inspected semiannually and replaced if dirty. Replacement filters may be ordered directly from Thomas Industries, Inc., Power Air Division, 1419 Illinois Avenue, Sheboygen, Wisconsin 53081.



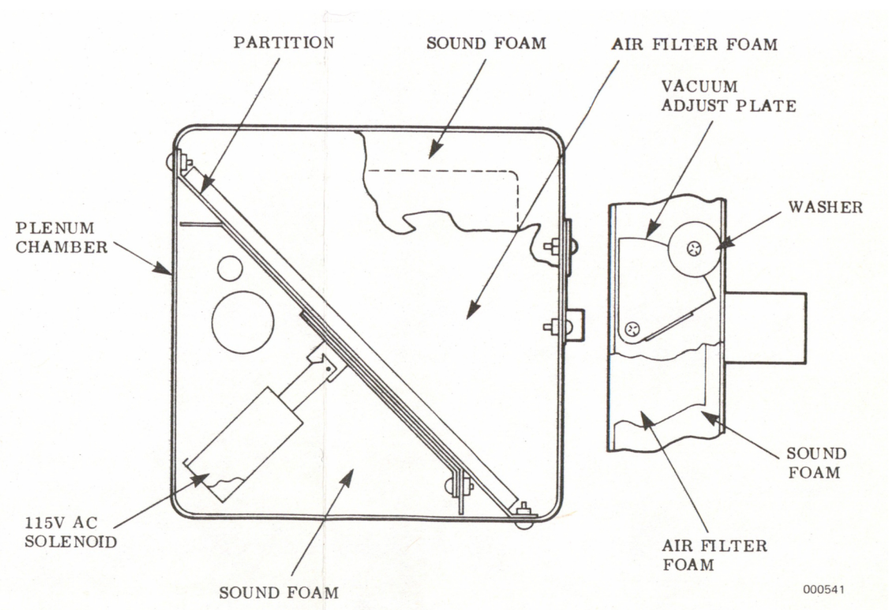


Figure 6-3. Vacuum Plenum Chamber - Filter Cleaning

SECTION 7
PERFORMANCE CHECKS

SECTION 7

PERFORMANCE CHECKS

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SECTION 7A

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Section 7, Performance Checks, contains information on the system performance. These will be broken down into:

a. Those checks concerned with the tape motion and tape transport preformance, Section 7.

b. Direct record/reproduce systems, Section 7A.

c. FM record/reproduce systems, Section 7B.

If the above checks indicate there are out-of-tolerance operating conditions then refer to the following sections/manuals for corrective maintenance procedures:

a. For FR3000 Tape Transport assemblies, see sections 9 through 11 of the FR3000 Tape Transport Maintenance Manual, Ampex part number 1802854.

b. For FR3010 Signal Electronics assemblies, see sections 8 through 10 of this manual, Ampex part number 1802852.

TAPE TRANSPORT CHECKS

TOOLS OR TEST EQUIPMENT REQUIRED

Oscilloscope.
Digital Voltmeter.

TRANSPORT CONFIDENCE CHECK

To verify that the tape transport is operating properly, the following procedure should be performed approximately once a month, and before any important data-recording operations. It should be followed by performance of the TEST SELECTOR switch check which follows.

To make a confidence check of the ac power, control logic, the servo systems, and the speed selection functions of the tape transport, proceed as follows:

a. Set main circuit breaker CB501 to ON. See that ac power indicator DS501 next to it lights.

b. Load a reel of tape onto the transport.

c. Press the POWER pushbutton switch on the control unit to turn power on. See that the POWER pushbutton lamp lights. When the vacuum blower provides adequate vacuum in the vacuum chamber the STOP READY pushbutton lights.

d. Check that the air compressor is providing adequate pressure to the air guides (1.5 to 2 psi on the compressor assembly gage).

e. Check that the vacuum level is correct, as read on the vacuum housing assembly gage. Refer to Table 7-1 for correct vacuum levels.

NOTE

For convenience and correctness in checking the vacuum, it is recommended that the column in the table giving the vacuum value(s) chosen for your machine be marked. (The table makes provision for such marking).

f. Initiate the forward mode at a tape speed of 1-7/8 ips.

g. Observe that the SYNC indicator lights.

h. With one hand, grasp one of the reels on the tape transport and stop it from turning. Observe that the capstan stops rotating and the SYNC indicator goes out.

i. Release the reel. If the reel was held for more than 2 seconds, the run command is lost and the STOP pushbutton must be pressed before the run command can be generated again. Therefore, if the capstan does not pull tape when the reel is released, press the STOP pushbutton, then press the FWD pushbutton. The tape should now move forward again.

j. Select 30 ips tape speed and observe that the capstan and reels accelerate smoothly to the new tape speed. Stop the transport.

k. Perform this same check in the reverse mode also.

Table 7-1. Recommended Vacuum Settings for High Speed Range

Tape Speed (ips)	VACUUM (Inches of Water)		
	1 Speed	2 or 3 Speed Nominal	6 Speed Nominal
1-7/8	11	11	11-1/2
3-3/4	11-1/2		
7-1/2	12	12	
15	13		
30	13-1/2	14	
60	14		
120	15-1/2	15-1/2	15-1/2
MARK (X or ✓) COLUMN TO BE USED			

TEST SELECTOR SWITCH CHECK

The TEST SELECTOR switch (S1 of the power and servo chassis) is located on the power and servo chassis test panel. It provides a means of checking various voltages and signals in the tape transport. It is used both for preventive maintenance and troubleshooting. To use the TEST SELECTOR switch for preventive maintenance, proceed as follows, using a digital voltmeter (1%) and an oscilloscope. Perform the procedure approximately once a month, and before any important data-recording operation, in conjunction with the above confidence check.

a. Connect an oscilloscope to the TEST SELECTOR bnc connector, J21, on the inner test panel.

b. Install and thread a reel of degaussed tape on the tape transport.

c. Ascertain the equipment is connected to 115V ac (230V ac for International versions) and that the ac power on indicator lamp, on the power panel, is lit.

d. Press the POWER pushbutton on the control unit to turn the tape transport power on. The slack in the tape should be drawn into the vacuum chambers. When the required pressure is established, the parking brakes release should be audible to the operator and the STOP/READY lamp should light.

e. Turn the TEST SELECTOR switch to +12V and measure the voltage. It should be +12(±0.5)V.

f. Turn the TEST SELECTOR switch to -12V position and measure the voltage. It should be -12(±0.2)V.

g. Turn the TEST SELECTOR switch to +5V position and measure the voltage. It should be +5(±0.5)V.

h. Turn the TEST SELECTOR switch to the +14V TAKE UP REELS position and measure the voltage. It should be +14(±2.0)V.

TAPE MOTION AND TAPE TRANSPORT (CONT)

i. Turn the TEST SELECTOR switch to the -16V TAKE UP REELS position and measure the voltage. It should be -16(±2.0)V.

j. Turn the TEST SELECTOR switch to the +28V CAPST position and measure the voltage. It should be +28 (±3.0)V.

k. Turn the TEST SELECTOR switch to the +28 SOLENOID position and measure the voltage. It should be +28(±3.0)V.

l. Turn the TEST SELECTOR switch to the -12V AIR SW position and measure the voltage. It should be -12(±2.0)V.

m. Turn the TEST SELECTOR switch to the TACH OUT position. With the tape transport in the standby condition (STOP/READY lamp lit), observe the oscilloscope display while moving the capstan puck by hand. A square wave should be displayed while the puck is in motion.

n. Turn the TEST SELECTOR switch to the -16V CAPST position and measure the voltage. It should be -16(±2.0)V.

o. Turn the TEST SELECTOR switch to the +14V SUPPLY REEL position and measure the voltage. It should be +14(±2.0)V.

p. Turn the TEST SELECTOR switch to -16V SUPPLY REEL position and measure the voltage. It should be -16(±2.0)V.

q. Turn the TEST SELECTOR switch to the PILOT SPLY position and measure the voltage. It should be +30(±2.0)V when POWER pushbutton is in the off position and +24(±2.0)V when POWER pushbutton is in the on position.

r. Turn the TEST SELECTOR switch to the RUN CMD position, press the forward pushbutton on at control panel, and measure the voltage. It should be +10(±1.0)V.

s. Turn the TEST SELECTOR switch to the OFF position. If all checks have been satisfactory, the equipment is ready for recording or reproducing. If the checks are not satisfactory, use normal troubleshooting techniques and alignment procedures to be found in the FR3000 Tape Transport Maintenance Manual, Ampex 1802854, Sections 9 and 10.

OPERATING MODE AND TAPE TRACKING CHECK

The operating mode and tape tracking check consists of observing operating conditions of the tape transport while moving tape. Perform the check as follows:

a. Load tape for normal operation and turn on system power.

b. Operate the tape transport in all modes, at all speeds and in both directions. Verify that the tape transport responds correctly to all of the mode commands and tape speed changes. If maintenance or adjustment is required, refer to the FR3000 Tape Transport Maintenance Manual, Ampex 1802854, Sections 8 through 12.

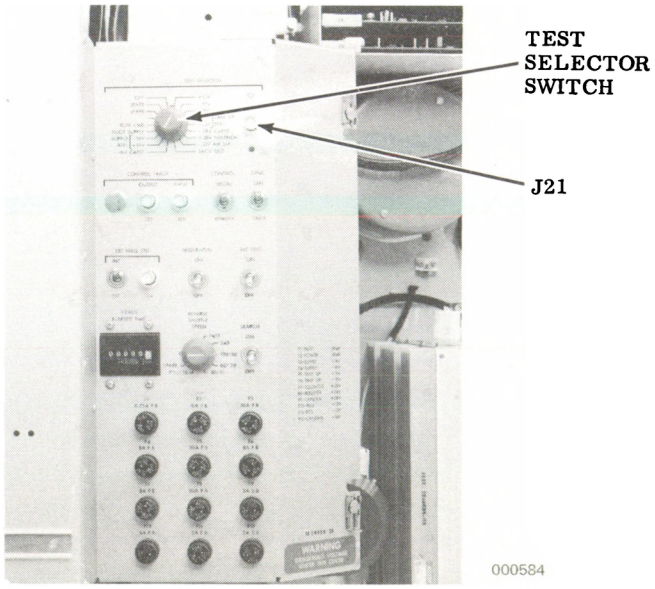

Figure 7-1. FR-3000 Transport Inner Test Panel

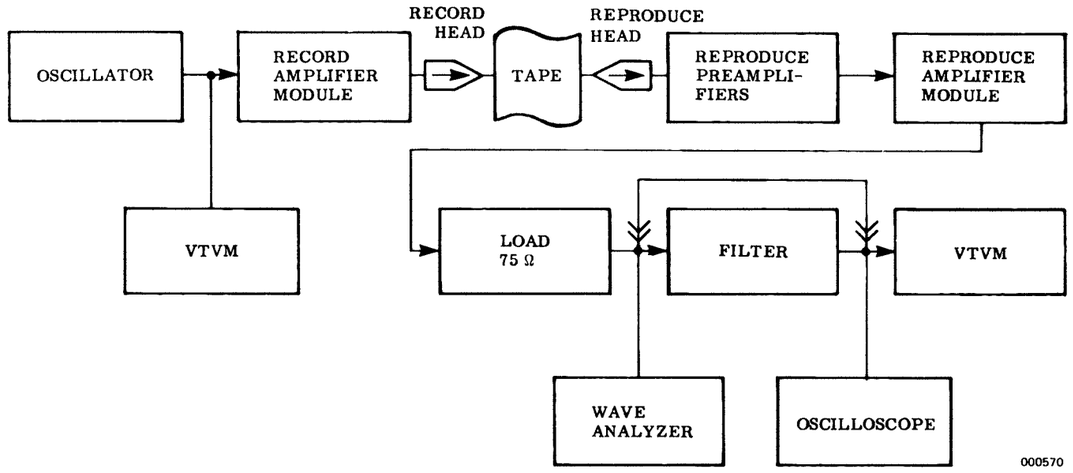

Figure 7A-1. Direct Record/Reproduce System Test Setup

Table 7A-1. Test Equipment Required for Direct Signal System Checks

Test Equipment	Characteristics, Identification or Type
VTVM	Accuracy within ±5% fs, from 10 Hz to 4 MHz, true rms reading.
Sine-wave Oscillator	Noise, total distortion and spurious components to be below 0.25% for frequency range under test.
Oscillscope	Time base and reading accuracy should be sufficient to avoid degrading the measurement of equipment performance.
Bandpass Filter	Adjustable from 50 Hz to 2 MHz. Down no more than 3 dB at the band edge frequency. 18 dB per octave rolloff.
Wave Analyzer	Calibrated to an accuracy of 0.5 dB. Dynamic range of at least 50 dB.
Load	75Ω

SECTION 7A DIRECT PERFORMANCE CHECKS

2.0/1.5 MHz WIDEBAND DIRECT SIGNAL ELECTRONICS

GENERAL

TEST EQUIPMENT AND TOOLS

The test equipment setup for the electronic performance checks is shown in Figure 7A-1. The tools and materials required are listed in Table 7A-1.

DEFINITIONS - DIRECT

OPERATING INPUT LEVEL. Any data input level to the record amplifier, which falls between the minimum and maximum levels listed on the specification sheet, shall be known as the OPERATING INPUT LEVEL.

STANDARD RECORD LEVEL. The Record Level control is adjusted with a given input signal to produce a signal at the output of the reproduce amplifier which contains 1% third order harmonic distortion. This input signal shall be known as the STANDARD RECORD LEVEL signal. (This is similar to "Normal Record Level" as defined in IRIG 106-73.)

STANDARD OUTPUT LEVEL. The Reproduce Output Level control is normally adjusted to produce an output signal amplitude of 1 volt rms, as measured across the proper terminating impedance, when reproducing a STANDARD RECORD LEVEL signal. This signal shall be known as the STANDARD OUTPUT LEVEL signal. (Values other than 1 volt rms may be used, but degradation in signal-to-noise or distortion may result.)

OPERATING INPUT LEVEL UNKNOWN. Equipment is normally adjusted at the factory utilizing 1 volt rms for the STANDARD RECORD LEVEL. On site alignment may be made with a test signal generator producing either the sites' preferred STANDARD RECORD LEVEL or the factory STANDARD RECORD LEVEL.

CONFIDENCE CHECK OF 2.0/1.5 MHZ WIDEBAND DIRECT SIGNAL ELECTRONICS

Using the direct record/reproduce system test setup (Figure 7A-1) the operator can preform a confidence check of the signal electronics by the following procedures:

a. Apply the record level set frequency at the operating input level, (see Tables 7A-2 and 7A-3), to the input receptacle of the record amplifier for the desired channel.

b. Connect an oscilloscope to the output receptacle of the reproduce electronics of that same channel. Terminate output with 75Ω load.

c. Initiate the record mode at the tape speed to be checked by simultaneously pressing RECORD and forward (FWD) pushbuttons.

d. The oscilloscope should display a 1V rms (2.8V p-p) reproduction of the frequency recorded (Standard Output Level).

If the check indicates that adjustment of the signal electronics is needed, follow the adjustment procedures to be found in Section 8 of this manual. If corrective maintenance is needed, refer to Sections 9 and 10 of this manual.

DIRECT FREQUENCY RESPONSE CHECK

The purpose of this check is to measure the system frequency response at discrete frequencies on the reproduce head curve. To check frequency response, proceed as follows:

a. Connect the oscillator to the channel 1 input jack at the rear of the signal electronics bay.

b. Set oscillator to the 0.1 upper bandedge frequency (record level set frequency) at the operating input level for the highest tape speed to be checked. Refer to Table 7A-2 for 2.0 wideband and Table 7A-3 for 1.5 wideband electronics.

c. Switch to the highest tape speed for which signal electronics is available and initiate the forward record mode. Set reproduce output level control for the standard output level (1V rms).

Table 7A-2. 2.0 MHz Wideband Direct Setup Frequencies

SPEED	REPRO REF FREQ	PEAK FREQ	LOW BAND-EDGE	UPPER BAND-EDGE	RECORD LEVEL SET FREQ	2/3 UPPER BAND-EDGE
120	200 kHz	300 kHz	400 Hz	2 MHz	200 kHz	1.33 MHz
60	100 kHz	150 kHz	400 Hz	1 MHz	100 kHz	666 kHz
30	50 kHz	80 kHz	400 Hz	500 kHz	50 kHz	333 kHz
15	25 kHz	50 kHz	400 Hz	250 kHz	25.0 kHz	166 kHz
7-1/2	12.5 kHz	22 kHz	400 Hz	125 kHz	12.5 kHz	83.2 kHz
3-3/4	6.25 kHz	10 kHz	400 Hz	62.5 kHz	6.25 kHz	41.6 kHz
1-7/8	3.125 kHz	5 kHz	400 Hz	31.25 kHz	3.125 kHz	20.8 kHz

Table 7A-3. 1.5 MHz Wideband Direct Setup Frequencies

SPEED	REPRO REF FREQUENCY	PEAK FREQUENCY	LOW BANDEDGE	UPPER BANDEDGE	RECORD LEVEL SET FREQUENCY
120	150 kHz	250 kHz	400 Hz	1.5 MHz	150 kHz
60	75 kHz	150 kHz	400 Hz	750 kHz	75 kHz
30	37.5 kHz	75 kHz	400 Hz	375 kHz	37.5 kHz
15	18.7 kHz	36 kHz	400 Hz	187 kHz	18.7 kHz
7-1/2	9.3 kHz	20 kHz	400 Hz	93 kHz	9.3 kHz
3-3/4	4.6 kHz	10 kHz	400 Hz	46 kHz	4.6 kHz
1-7/8	2.3 kHz	5 kHz	400 Hz	23 kHz	2.3 kHz

d. Sweep the oscillator through a frequency range from the low bandedge to the upper bandedge and check for peaks or valleys outside ±3 dB of the level of step c.

e. Press the STOP pushbutton.

f. Repeat steps a through e for all the remaining channels and at all other tape speeds for which signal electronics are available.

If at the completion of the frequency response check, peaks or valleys outside ±3 dB spread are present, a complete readjustment may be necessary (refer to Section 8 of this manual). If the response is within ±3 dB, the equipment is fully aligned and a signal-to-noise ratio check may be carried out.

DIRECT SIGNAL-TO-NOISE RATIO CHECK

To check the signal-to-noise ratio, proceed as follows:

a. Set up the test equipment as shown in Figure 7A-1 but with the filter connected.

b. Set the filter for a frequency range to pass a band of frequencies from the low to the upper bandedge for the tape speed being checked.

c. Switch to the tape speed being checked and to forward record mode.

d. Play back a signal (input at the operating input level) at the upper bandedge frequency and check that output level with the filter connected is now minus 6 dB from the Standard Output Level (1V rms).

NOTE

Step d is not necessary if the frequency response procedure has been carried out.

e. Set the oscillator to the operating input level at the record level set frequency and note the reproduce output level.

f. Disconnect the oscillator and substitute a short circuit at the input.

g. Observe and note the reproduce output level with the true rms voltmeter.

h. Determine the difference in dB between the reading obtained in step e and the reading obtained in step g. This is the signal-to-noise ratio.

i. Repeat steps d through h for the remaining channels and at other tape speeds.

j. If, at the completion of the signal-to-noise ratio check, the signal-to-noise ratio does not meet published specifications, a complete realignment (readjustment) may be necessary (refer to Section 8 of this manual).

SECOND ORDER HARMONIC DISTORTION CHECK

In order to ensure that the heads are not gaussed (magnetized) and that the SECOND HARMONIC controls are not misadjusted, check the second order harmonic content of a reproduced test signal as follows:

NOTE

No second harmonic check of the servo control track channel is required.

a. Set up the test equipment as shown in Figure 7A-1, with the filter out of the circuit. The vtvm at the output is not required. Set the oscillator for the normal operating input level of the first channel to be checked, and at a frequency of two times the record level set frequency.

b. With fully degaussed tape installed, operate the recorder in record mode at the tape speed being checked.

c. Tune the wave analyzer to the signal being reproduced (two times the record level set frequency), (see Tables 7A-2 and 7A-3). Set the reference adjustment of the wave analyzer for a reference level.

d. Leave the analyzer tuned to two times the record level set frequency. Tune the oscillator to the record level set frequency, maintaining the level established in step a. Increase the input sensitivity of the wave analyzer (utilizing the step attenuator only), and fine-tune the oscillator until the wave analyzer is reading two times the record level set frequency (second harmonic of the reproduced record level set frequency oscillator signal).

e. The reading should be at least -46 dB from the reference level. If it is not, refer to the alignment procedures in Section 8 of this manual. Magnetized heads will seriously degrade the second harmonic reading.

f. Repeat steps a through e for the remaining channels except for the servo control track channel.

GENERAL

TEST EQUIPMENT AND TOOLS

The test equipment setup for the electronic performance checks is shown in Figure 7A-1 on page 7A-1. The tools and materials required are listed in Table 7A-1 on page 7A-1 of this section.

DEFINITIONS - DIRECT

OPERATING INPUT LEVEL. Any data input level to the record amplifier, which falls between the minimum and maximum levels listed on the specification sheet, shall be known as the OPERATING INPUT LEVEL.

STANDARD RECORD LEVEL. The Record Level control is adjusted with a given input signal to produce a signal at the output of the reproduce amplifier which contains 1% third order harmonic distortion. This input signal shall be known as the STANDARD RECORD LEVEL signal. (This is similar to "Normal Record Level" as defined in IRIG 106-73.)

STANDARD OUTPUT LEVEL. The Reproduce Output Level control is normally adjusted to produce an output signal amplitude of 1 volt rms, as measured across the proper terminating impedance, when reproducing a STANDARD RECORD LEVEL signal. This signal shall be known as the STANDARD OUTPUT LEVEL signal. (Values other than 1 volt rms may be used, but degradation in signal-to-noise or distortion may result.)

OPERATING INPUT LEVEL UNKNOWN. Equipment is normally adjusted at the factory utilizing 1 volt rms for the STANDARD RECORD LEVEL. On site alignment may be made with a test signal generator producing either the sites' preferred STANDARD RECORD LEVEL, or the factory STANDARD RECORD LEVEL.

CONFIDENCE CHECK OF INTERMEDIATE BAND SIGNAL ELECTRONICS

Using the direct record/reproduce system setup (Figure 7A-1) the operator can preform a confidence check of the signal electronics by the following procedure:

a. Apply the record level set frequency for the tape speed to be checked (see Table 7A-4) at the operating input level to the input receptacle of the record amplifier for the desired channel.

b. Connect an oscilloscope to the output receptacle of the reproduce electronics of that same channel. Terminate output with 75Ω load.

c. Initiate the record mode at the highest tape speed to be checked by simultaneously pressing RECORD and the forward (FWD) pushbuttons.

d. The oscilloscope should display a 1V rms (2.8V p-p) reproduction of the frequency recorded (standard output level).

If the check indicates that a realignment of the signal electronics is needed, proceed with alignment procedures in Section 8 of this manual. If corrective maintenance of the signal electronics is needed, refer to sections 9 and 10 of this manual.

DIRECT FREQUENCY RESPONSE CHECK

The purpose of this check is to measure the system frequency response at discrete frequencies on the reproduce head curve. To check frequency response, proceed as follows:

a. Connect the oscillator to the channel 1 input jack at the rear of the signal electronics bay.

b. Set the oscillator to the low bandedge frequency at the operating input level. (Low bandedge for the highest tape speed to be checked, refer to Table 7A-4.)

c. Switch to the highest tape speed for which signal electronics is available and initiate the forward record mode. Set reproduce output level control for a 1V rms output (standard output level).

Table 7A-4. Intermediate Band Setup Frequencies

SPEED	REPRO REF FREQUENCY	PEAK FREQUENCY	LOW BANDEDGE	UPPER BANDEDGE	RECORD LEVEL SET FREQUENCY
120	60 kHz	64 kHz	300 Hz	600 kHz	60 kHz
60	30 kHz	36 kHz	300 Hz	300 kHz	30 kHz
30	15 kHz	22 kHz	150 Hz	150 kHz	15 kHz
15	7.5 kHz	14 kHz	100 Hz	75 kHz	7.5 kHz
7-1/2	3.75 kHz	7 kHz	100 Hz	38 kHz	3.75 kHz
3-3/4	1.875 kHz	4.5 kHz	100 Hz	19 kHz	1.875 kHz
1-7/8	937 Hz	2.5 kHz	100 Hz	10 kHz	937 Hz

d. Sweep the oscillator through a frequency range from the low bandedge to the upper bandedge and check for peaks or valleys outside ±3 dB of the level of step c.

e. Press the STOP pushbutton.

f. Repeat steps a through e for all the remaining channels and at all other tape speeds for which signal electronics are available.

If, at the completion of the frequency response check, peaks or valleys outside ±3 dB are present, a complete readjustment may be necessary (refer to Section 8 of this manual). If the response is within ±3 dB, the equipment is fully aligned and a signal-to-noise check may now be carried out.

DIRECT SIGNAL-TO-NOISE RATIO CHECK

To check the signal-to-noise ratio, proceed as follows:

a. Set up the test equipment as shown in Figure 7A-1 (on page 7A-1) with the filter connected into circuit.

b. Set the filter for a frequency range to pass a band of frequencies from the low to the upper bandedge for the tape speed being checked.

c. Switch to the tape speed being checked and to forward record mode.

d. Play back a signal (input at operating input level) at the upper bandedge frequency (the upper bandedge output is normally set to -2 to -3 dB), and check that output level with the filter connected is now minus 6 dB from the standard output level (1V rms).

NOTE

Step d is not necessary if the frequency response procedure has been carried out.

e. Set the oscillator to the operating input level at the record level set frequency and note the reproduce output level.

f. Disconnect the oscillator and substitute a short circuit at the input.

g. Observe and note the reproduce output level with the true rms voltmeter.

h. Determine the difference in dB between the reading obtained in step e and the reading obtained in step g. This is the signal-to-noise ratio.

i. Repeat steps d through h for the remaining channels and at other tape speeds.

j. If, at the completion of the signal-to-noise ratio check, the signal-to-noise ratio does not meet published specifications, a complete readjustment may be necessary (refer to Section 8 of this manual).

SECOND ORDER HARMONIC DISTORTION CHECK

In order to ensure that the heads are not gaussed (magnetized) and that the SECOND HARMONIC controls are not misadjusted, check the second order harmonic content of a reproduced test signal as follows:

NOTE

No second harmonic check of the servo control track channel is required.

a. Set up the test equipment as shown in Figure 7A-1 (on page 7A-1), with the filter out of the circuit. The vtvm at the output is not required. Set the oscillator for the normal operating input level of the first channel to be checked, and at a frequency two times the record level set frequency.

b. With fully degaussed tape installed, operate the recorder in record mode at the tape speed being checked.

c. Tune the wave analyzer to two times the record level set frequency signal being reproduced (see Table 7A-4). Set the reference adjustment of the wave analyzer for a reference level.

d. Leave the analyzer tuned to two times the record level set frequency. Tune the oscillator to the record level set frequency, maintaining the level established in step a. Increase the input sensitivity of the wave analyzer (utilizing the step attenuator only), and fine-tune the oscillator until the wave analyzer is reading two times the record level set frequency (second harmonic of the reproduced record level set frequency oscillator signal.)

e. The reading should be at least -46 dB from the reference level. If it is not, refer to alignment procedures in Section 8 of this manual.

NOTE

Magnetized heads will seriously degrade the second harmonic reading.

f. Repeat steps a through e for the remaining channels except for the servo control track channel.

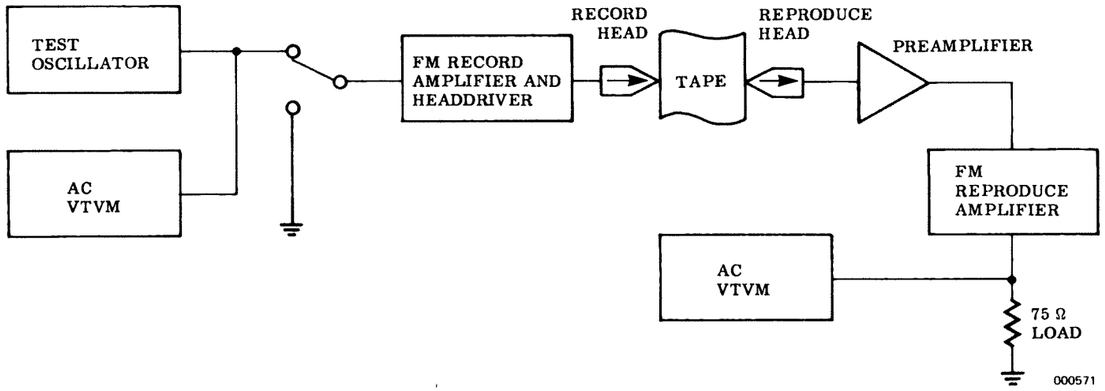

Figure 7B-1. Test Equipment Setup for FM Frequency and Signal-to-Noise Tests

Table 7B-1. Test Equipment Required for FM Signal Systems Checks

Test Equipment	Characteristics, Identification or Type
VTVM	Accuracy within ±5% fs, from 10 Hz to 4 MHz, true rms reading.
Sine-wave Oscillator	Noise, total distortion and spurious components to be below 0.25% for frequency range under test.
Oscilloscope	Time base and reading accuracy should be sufficient to avoid degrading the measurement of equipment performance.
Load	75Ω

STANDARD INPUT SIGNAL LEVEL

A standard input signal is applied to the fm record amplifier for test purposes. It is defined as: that input signal level which deviates the fm modulator from its center carrier frequency (ccf) ±30% for WII bipolar operation. If the fm modulation is configured for unipolar operation the fm carrier frequency will be deviated positive or negative 60% for WII operation.

The fm Performance Checks given in this section will use the following input voltage levels for test purposes.

a. A standard dc input at positive or negative 1.414V.

b. A standard ac input at 1V rms.

The fm modulator may be calibrated for other input signal levels if desired. Fm record input attenuator jumpering must be configured to accept the maximum peak voltage at its input.

STANDARD OUTPUT LEVEL

The reproduce output level control is normally adjusted to produce an output signal amplitude of 1V rms as measured across the proper terminating impedance, when reproducing a STANDARD INPUT SIGNAL LEVEL. This signal is known as the STANDARD OUTPUT LEVEL. (Values other than 1 volt rms may be used, but degradation in signal-to-noise or distortion may result.)

CONFIDENCE CHECK OF WII FM SIGNAL ELECTRONICS

The operator can perform a confidence check of the signal electronics by the following procedure:

a. Apply a 1000 Hz signal at the standard input signal level to the input receptacle of the signal electronics bay for the desired channel.

b. Connect an oscilloscope to the output receptacle of the reproduce electronics of that same channel. Terminate output with 75Ω load.

c. Initiate the record mode at the highest tape speed to be checked by simultaneously pressing RECORD and the forward pushbuttons.

d. The oscilloscope should display a 1V rms reproduction of the frequency recorded.

If the check indicates that a readjustment of the signal electronics is needed proceed with adjustment procedures in Section 8 of this manual. If corrective maintenance of the signal electronics is needed, refer to the sections 9 and 10 of this manual.

FM FREQUENCY RESPONSE CHECK

Test for frequency response as follows:

a. Connect test equipment as shown in Figure 7B-1.

b. Adjust the sine-wave oscillator to the reference frequency for the highest tape speed to be checked (see Table 7B-2).

c. Set the oscillator level to the same as that used to calibrate the record and reproduce systems (normally the standard input signal level - 1V rms).

d. Turn system power and transport power on. Switch to the tape speed determined in step b, and into the forward-record mode.

Table 7B-2. FM Signal-to-Noise and Frequency Response Reference Frequency to WII

Tape Speed	Reference Frequency
1-7/8	100 Hz
120 thru 3-3/4	1 kHz

Table 7B-3. Wideband Group II (WII)

TAPE SPEED (ips)	CENTER CARRIER	CENTER CARRIER TOLERANCE (±0.1%)	MAX + DEVIATION +30%	MAX - DEVIATION -30%	FULL BAND DEVIATION	MODULATION FREQUENCY DC TO UPPER-BANDEDGE
120	900 kHz	±900 Hz	1170 kHz	630 kHz	540 kHz	500 kHz
60	450 kHz	±450 Hz	585 kHz	315 kHz	270 kHz	250 kHz
30	225 kHz	±225 Hz	292 kHz	157 kHz	135 kHz	125 kHz
15	112.5 kHz	±110 Hz	146 kHz	78.75 kHz	67.25 kHz	62.5 kHz
7-1/2	56.25 kHz	±56 Hz	73.125 kHz	39.375 kHz	33.75 kHz	31.25 kHz
3-3/4	28.125 kHz	±28 Hz	36.562 kHz	10.688 kHz	16.87 kHz	15.6 kHz
1-7/8	14.0625 kHz	±14 Hz	18.281 kHz	9.844 kHz	8.43 kHz	7.8 kHz

e. Note the output reading on the ac vtvm. This level will now be the reference level.

f. Slowly sweep the test oscillator through the frequency range from near dc to the upper data bandedge. (See Table 7B-3.)

g. Maintain the oscillator input level set in step c. Observe and log the excursions in dB of the reproduced output level with respect to the reading obtained in step e.

h. Press the transport STOP pushbutton.

i. Compare the excursion readings of step g to the specifications for the type of fm electronics in use.

NOTE

The WII bandwidth should be no more than 1 dB down from dc to 0.32 of the upper data bandedge, no more than 4 dB down for 0.8 of the upper data bandedge, and no more than 6 dB down at the upper data bandedge.

j. If the readings of step i are not within specification, readjustments of the complete electronics system may be necessary. Refer to Section 8 of this manual.

k. If the readings of step i are within specification, conduct frequency response tests on the remaining channels and at other tape speeds for which data filters are available.

FM SIGNAL-TO-NOISE RATIO CHECK

The signal-to-noise ratio test is performed as follows:

a. Use a reference frequency of 1 kHz for this test.

b. Connect the test equipment as shown in Figure 7B-1 on page 7B-1.

c. Set the sine-wave oscillator to the reference frequency.

d. Set the oscillator level to the same as that used to calibrate the record and reproduce systems (normally 1V rms).

e. Turn system power and transport power on. Switch to the tape speed determined in step c and operate the transport in the forward-record mode.

f. Note the output reading on the ac vtvm. This level will now be the reference level.

g. Disconnect the oscillator and short the fm modulator input to ground. Read the demodulator output as indicated on the electronic voltmeter.

h. Compare the readings of step f with step g. This is the signal-to-noise ratio.

i. If the value in step h is within specification, repeat steps a through h for the rest of the tape speeds available.

j. If the value in step h is not within specification, a complete electronic system readjustment may be necessary. Refer to Section 8 of this manual.

NOTE

Frequent causes of poor signal-to-noise ratio are dirty heads, magnetized heads, and tape not thoroughly degaussed. Other causes may be carrier level control (modulator), head normalizing potentiometer (demodulator) improperly set, bias level improperly set (D. C. BAL. and AC BIAS), wrong type of tape being used in the recorder/reproducer or the tape transport flutter is out of specifications.

k. Perform the signal-to-noise ratio test on the remaining channels.

STANDARD INPUT SIGNAL LEVEL

A standard input signal is applied to the fm record amplifier for test purposes. It is defined as: that input signal level which deviates the fm modulator from its center carrier frequency (ccf) ±40% for WIL bipolar operation. If the fm modulation is configured for unipolar operation the fm carrier frequency will be deviated positive or negative 80% for WIL operation.

The fm Performance Checks given in this section will use the following input voltage levels for test purposes.

a. A standard dc input at positive or negative 1.414V.

b. A standard ac input at 1V rms.

The fm modulator may be calibrated for other input signal levels if desired. Fm record input attenuator jumpering must be configured to accept the maximum peak voltage at its input.

STANDARD OUTPUT LEVEL

The reproduce output level control is normally adjusted to produce an output signal amplitude of 1V rms as measured across the proper terminating impedance, when reproducing a STANDARD INPUT SIGNAL LEVEL. This signal is known as the STANDARD OUTPUT LEVEL. (Values other than 1 volt rms may be used, but degradation in signal-to-noise or distortion may result.)

CONFIDENCE CHECK OF WIL BAND FM SIGNAL ELECTRONICS

The operator can perform a confidence check of the signal electronics by the following procedure:

a. Apply a 1,000 Hz signal at the standard input signal level, to the input receptacle of the signal electronics tray for the desired channel.

b. Connect an oscilloscope to the output receptacle of the reproduce electronics of that same channel. Terminate output with 75Ω load.

c. Initiate the record mode at the highest tape speed to be checked by simultaneously pressing RECORD and the forward (FWD) pushbuttons.

d. The oscilloscope should display a 1V rms reproduction of the frequency recorded.

If the check indicates that a readjustment of the signal electronics is needed proceed with adjustment procedures in Section 8 of this manual. If corrective maintenance of the signal electronics is needed, refer to the sections 9 and 10 of this manual.

Table 7B-4 FM Signal-to-noise and Frequency Response Reference Frequencies for WIL

TAPE SPEEDS PER BANDWIDTH (ips)			REFERENCE FREQUENCY
W	I	L	
1-7/8	3-3/4 thru 1-7/8	7-1/2 thru 1-7/8	100 Hz
120 thru 3-3/4	120 thru 7-1/2	120 thru 15	1 kHz

Table 7B-5. Wideband Group I, Intermediate Band, and Lowband (WIL)

TAPE SPEED (ips)			CENTER CARRIER	MODULATION FREQUENCY DC TO UPPER BANDEDGE		
W	I	L		W	I	L
120	. . .	. . .	432 kHz	80 kHz	. . .	. . .
60	120	. . .	216 kHz	40 kHz	40 kHz	. . .
30	60	120	108 kHz	20 kHz	20 kHz	20 kHz
15	30	60	54 kHz	10 kHz	10 kHz	10 kHz
7-1/2	15	30	27 kHz	5 kHz	5 kHz	5 kHz
3-3/4	7-1/2	15	13.5 kHz	2.5 kHz	2.5 kHz	2.5 kHz
1-7/8	3-3/4	7-1/2	6.75 kHz	1.25 kHz	1.25 kHz	1.25 kHz
. . .	1-7/8	3-3/4	3.375 kHz	. . .	625 Hz	625 Hz
. . .	. . .	1-7/8	1.6875 kHz	. . .	. . .	312 Hz

FM FREQUENCY RESPONSE CHECK

Test for frequency response as follows:

a. Connect test equipment as shown in Figure 7B-1.

b. Adjust the sine-wave oscillator to the reference frequency for the highest tape speed to be checked. Refer to Table 7B-4.

c. Set the oscillator level to the same as that used to calibrate the record and reproduce systems (normally the standard input signal level - 1V rms).

d. Turn system power and transport power on. Switch to the tape speed determined in step b, and into the forward record mode.

e. Note the output reading on the ac vtvm. This level will now be the reference level.

f. Slowly sweep the test oscillator through the frequency range from near dc to the upper data bandage. Refer to Table 7B-5.

g. Maintain the oscillator input level set in step c. Observe and log the excursions in dB of the reproduced output level with respect to the reading obtained in step e.

h. Press the transport STOP pushbutton.

i. Compare the excursion readings of step g to the specifications for the type of fm electronics in use.

NOTE

The WIL bandwidth should be flat ±1/2 dB dc to upper data bandedge.

j. If the readings of step i are not within specification, readjustment of the complete electronics system may be necessary. Refer to Section 8 of this manual.

k. If the readings of step i are within specification, conduct frequency response tests on the remaining channels and at the other tape speeds for which data filters are available.

FM SIGNAL-TO-NOISE RATIO CHECK

The signal-to-noise ratio test is performed as follows:

a. Refer to Table 7B-4 for the reference frequencies for this test.

b. Connect the test equipment as shown in Figure 7B-1.

c. Set the sine-wave oscillator to the reference frequency given in Table 7B-4 for the highest tape speed to be checked.

d. Set the oscillator level to the same as that used to calibrate the record and reproduce systems (normally the standard input signal level - 1V rms).

e. Turn system power and transport power on. Switch to the tape speed determined in step c and operate the transport in the forward record mode.

f. Note the output reading on the ac vtvm. This level will now be the reference level.

g. Disconnect the oscillator and ground the fm modulator input. Read the demodulator output as indicated on the electronic voltmeter.

h. Compare the readings of step f with step g. This is the signal-to-noise ratio.

i. If the value in step h is within specification, repeat steps a through h for the rest of the tape speeds available.

j. If the value in step h is not within specification, a complete electronic system readjustment may be necessary. Refer to Section 8 of this manual.

NOTE

Frequent causes of poor signal-to-noise ratio are dirty heads, magnetized heads, and tape not thoroughly degaussed. Other causes may be carrier level control (modulator), head normalizing potentiometer (demodulator) improperly set, bias level or second harmonic adjust improperly set, the wrong type of tape being used in the recorder/reproducer or tape transport flutter out of specifications.

k. Perform the signal-to-noise ratio test on the remaining channels.

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ADJUSTMENT PROCEDURES

SECTION 8

ADJUSTMENT PROCEDURES

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SECTION 8
ADJUSTMENT PROCEDURES

CONTENTS OF SECTION

Section 8 contains the adjustment procedures for the signal electronics and their power supplies. These are broken down into the following sub-sections:

a. Power supplies - Section 8

1. ±25V power supplies
2. +17V reference power supply (used only with FM.
3. Preamplifier power supply
4. Headdriver power supply (no adjustments necessary).

b. Direct record/reproduce systems - Section 8A

c. FM record/reproduce systems - Section 8B

The adjustments in this section should be performed whenever the performance checks contained in Section 7 of this manual indicate that the signal system (Direct, FM, and associated power supplies) does not meet published specifications.

If such adjustment procedures can not be made or there are marginal operating conditions, then refer to Sections 9 and 10 of this manual for troubleshooting or removal and replacement of component information.

TOOLS OR TEST EQUIPMENT REQUIRED

Test Equipment	Characteristics, Identification or Type
VTVM	Accuracy within ±5% fs, from 10 Hz to 4 MHz , true rms reading
Sine-wave Oscillator	Noise, total distortion and spurious components to be below 0.25% for frequency range under test
Oscilloscope	Time base and reading accuracy should be sufficient to avoid degrading the measurement of equipment performance.
Bandpass Filter	Adjustable from 50 Hz to 2 MHz. Down no more than 3 dB at the bandedge frequency. 18 dB per octave rolloff.
Wave Analyzer	Calibrated to an accuracy of 0.5 dB. Dynamic range of at least 50 dB.
Digital Voltmeter	Accuracy within ±0.1%
Dc voltage source	±1.414V or regulated adjustable source of dc
Electronic counter	Range dc to 10 MHz
Load	75Ω non-inductive ±10% 1/2W
Extender card	Ampex Part No. 1801658
Tuning tools	Non-metallic, 1/16" blade.
Extender card	Ampex Part No. 1802849

POWER SUPPLY ADJUSTMENTS

GENERAL

Most modern power supplies provide outputs which rarely need adjustment and those of the FR3010 are no exception. It is, however, desirable to check the power supply outputs under their normal loading on a regular basis, i.e., once every 3 months or when their operational status is unknown due to long term storage. Power supply checks and adjustment procedures which follow provide simple basic steps for maintaining the power supply outputs within their specified values.

SIGNAL ELECTRONICS TRAY POWER SUPPLY CHECK AND ADJUSTMENTS

Signal electronics tray power supply checks and adjustments should be made as follows:

a. Turn off system power.

b. Remove top cover plate at the rear of the electronics tray (see Figures 8-1 and 8-2).

c. Install normal number of channels of data signal electronics.

d. Install extender board, Ampex Part No. 1801658, in the calibrate slot of the signal electronics tray. Connect the negative lead of the digital voltmeter to terminal 5/E on the extender card and positive lead to chassis ground. Set the voltmeter scale to read -25V dc.

e. Turn the system and transport power on. Throw the REC TEST switch to ON (REC TEST switch is located on the inner transport test panel). The voltmeter should read -25(±0.1)V dc. If necessary adjust the -25V power supply potentiometer through the access hole in the power supply cover. Turn the system and transport power off.

f. Connect the positive lead of the digital voltmeter to terminal 6/F on the extender card with the negative lead to chassis ground. Set the voltmeter to read +25V dc.

g. Turn the system and transport power on. The voltmeter should read +25(±0.1)V dc. Adjust the +25V dc power supply potentiometer if necessary.

h. Turn the system and transport power off. If the system contains FM proceed to step j. If the system does not contain FM proceed to step i.

i. Return the REC TEST switch to OFF. Remove the test equipment and extender card (the extender card may be left in the calibrate slot for storage purposes). Replace the top cover plate on the power supply section of the signal electronics tray.

j. Connect the digital voltmeter to TP1 (red, +17V dc) and TP2 (black, ground) on the +17V regulator pwa. Turn on system power. The voltage should read +17(±0.01)V dc. If it does not, adjust potentiometer R9 on the +17V regulator pwa.

k. Turn off system power. Return REC TEST switch to the OFF position. Remove test equipment. Replace the top cover plate on the power supply section of the signal electronics tray.

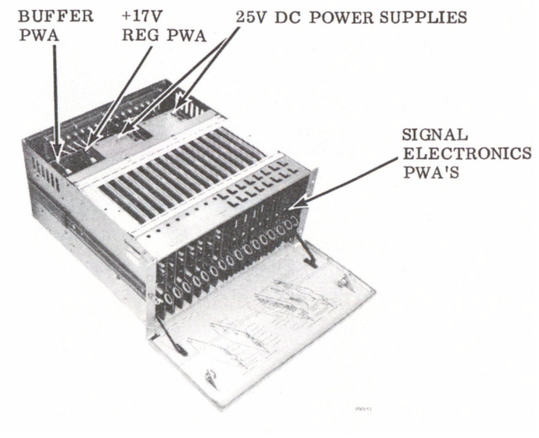


Figure 8-1. Signal Electronics Tray and Power Supplies -Overall View

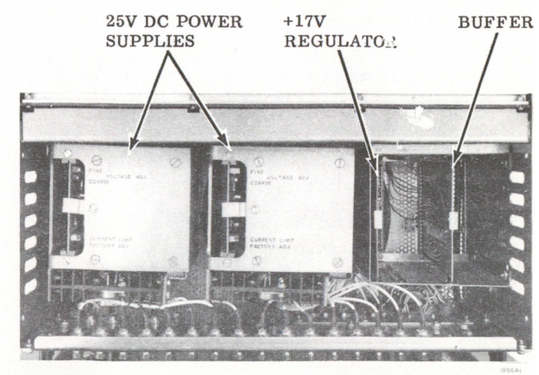


Figure 8-2. Signal Electronics Tray Power Supplies and Regulator PWA's- Top View

PREAMPLIFIER POWER SUPPLY CHECKS AND ADJUSTMENTS

To check and adjust the preamplifier power supply proceed as follows:

a. Turn off system power.

b. Remove the rear cover plate from the preamplifier #2 housing (Remove two 4-40 screws). See Figure 8-3.

c. Remove a preamplifier #2 pwa and insert preamplifier extender card (Ampex 1802849) in its place.

d. Insert preamplifier #2 pwa into extender card.

e. Connect digital voltmeter between test lug 2A (12V dc) and test lug 3A/3B (±12V common).

f. Turn on system power. Voltmeter should read -12.0(±0.2)V dc. Adjust R24 (-12V ADJ) if necessary. R24 (-12V ADJ) is located on the rear lower left side of the headdriver housing, (see Figure 8-4).

g. Turn system power off. Connect the positive lead of the digital voltmeter to test lug 2B (+12V) of the preamplifier extender card and the negative lead to test lug 3A/3B (±12V common).

h. Turn on system power. Voltmeter should read +12.0(±0.2)V dc. Adjust the +12V ADJ (R16) if necessary. +12V ADJ is located at the rear lower left side of the headdriver housing (see Figure 8-4).

i. There are two further adjustments in the preamplifier power supplies R12 and R20, both of which set the current overload point of the preamplifier power supply. These adjustments are factory adjustments and are not externally available on the power supply.

j. Turn off the system power. Remove the test equipment and extender card. Reinstall preamplifier #2 pwa.

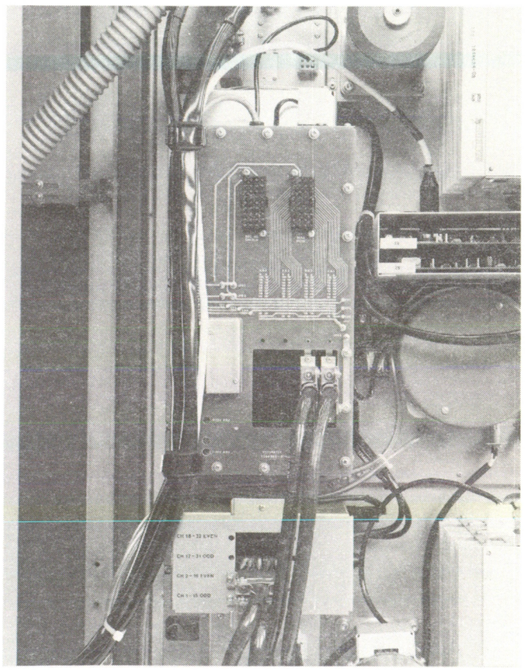


Figure 8-3. Preamplifier No. 2 Housing - Rear View

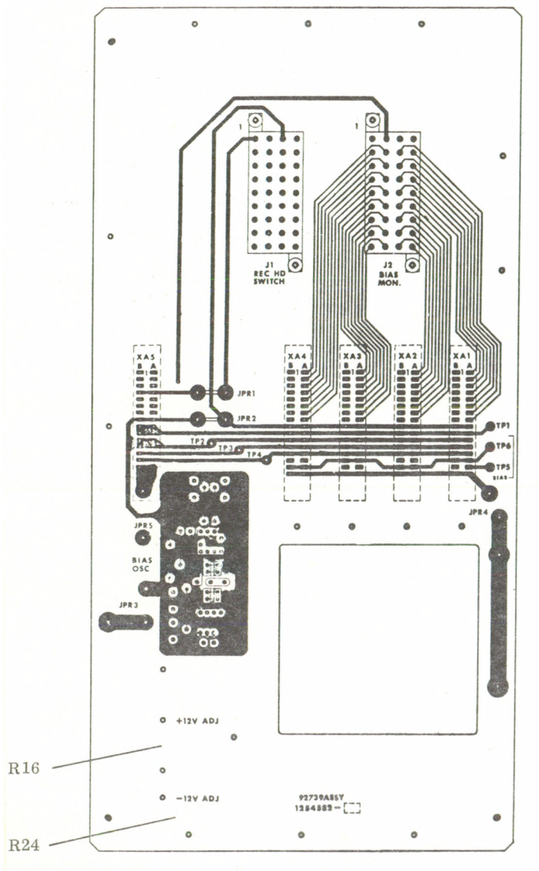


Figure 8-4. Headdriver Housing - Rear View - Showing Power Supply Adjustment

HEADDRIVER POWER SUPPLY CHECKS AND ADJUSTMENTS

There are no adjustments for the headdriver power supply. Checks may be made of the power supply voltages at the test points at the rear of the headdriver housing as follows:

Test point 1	+18(±1)V
Test Point 2	Common ground
Test Point 3	-12.0(±0.6)V
Test Point 4	+12.0(±0.6)V
Test Point 5 & 6	bias

If any of the above voltages are not available, refer to Sections 9 and 10 Troubleshooting and Removal and Replacements of this manual for corrective maintenance procedures.

SECTION 8A DIRECT ADJUSTMENT PROCEDURES

GENERAL

DEFINITIONS - DIRECT

OPERATING INPUT LEVEL. Any data input level to the record amplifier, which falls between the minimum and maximum levels listed on the specification sheet, shall be known as the OPERATING INPUT LEVEL.

STANDARD RECORD LEVEL. The Record Level control is adjusted with a given input signal to produce a signal at the output of the reproduce amplifier which contains 1% third order harmonic distortion. This input signal shall be known as the STANDARD RECORD LEVEL signal. (This is similar to "Normal Record Level" as defined in IRIG 106-73.)

STANDARD OUTPUT LEVEL. The Reproduce Output Level control is normally adjusted to produce an output signal amplitude of 1 volt rms, as measured across the proper terminating impedance, when reproducing a STANDARD RECORD LEVEL signal. This signal shall be known as the STANDARD OUTPUT LEVEL signal. (Values other than 1 volt rms may be used, but degradation in signal-to-noise or distortion may result.)

OPERATING INPUT LEVEL UNKNOWN. Equipment is normally adjusted at the factory utilizing 1 volt rms for the STANDARD RECORD LEVEL. On site alignment may be made with a test signal generator producing either the sites' preferred STANDARD RECORD LEVEL or the factory STANDARD RECORD LEVEL.

OPTIONAL RECORD LEVEL MONITORING SYSTEM

An optional record level monitoring system, comprising a series of level meters or oscilloscopes, one for each channel, is available for correct adjustment of the electronics to different levels of data signals. After calibration of the monitors at the 1% third harmonic distortion level, this monitoring provision allows the record amplifier to be adjusted for correctly recording signals of various levels by means of the channel gain control located on the front of the appropriate record amplifier module. Detailed information and schematics of the electronic assemblies are included in the FR3010 Signal Electronics manual 1802855.

INTERCHANGEABLE PWA'S

Interchangeable modular printed circuit cards are used throughout the FR3010 Signal Electronics system. Interchange of these modules should not be made after system alignment unless the channels affected by the interchange are realigned.

ADJUSTMENTS

PREADJUSTMENT FUNCTIONS

Perform the following preadjustment functions:

a. Place the jumpers on the direct record and reproduce amplifier pwa's in the following configuration:

   1. Set record jumpers to match desired input impedance and input level range as per Figure 8A-1.

   2. Reproduce E1-E2, selects the correct bias trap. Refer to Figure 8A-2.

   3. Reproduce E5-E6, selects gain for wideband operation.

   4. Reproduce E13-E14 and E9-E10, inserts 400 Hz high pass filter.

b. Set R27 REC LEVEL, on the record amplifier, at midrange. (See Figures 8A-3 and 8A-5.)

c. Set INPUT LEVEL R4 and GAIN ADJ R48, on the reproduce amplifier, at midrange. (See Figures 8A-3 and 8A-6.)

d. Terminate the reproduce amplifier in 75Ω.

e. Using a convenient input signal reference level perform the following adjustments in the order listed:

   1. Bias - followed by

   2. Record level and second harmonic level - followed by

   3. Reproduce head azimuth - followed by

   4. Reproduce level - followed by

   5. Equalizer adjustments.

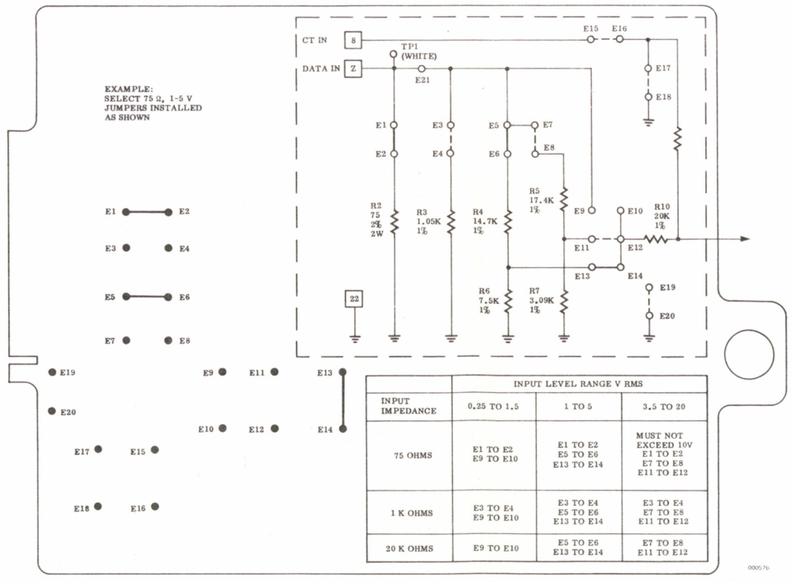
BIAS LEVEL ADJUSTMENT

To adjust the bias level, proceed as follows:

a. Set up the test equipment as shown in Figure 8A-4 with the filter disconnected (jumpered).

b. Connect the oscillator to the channel 1 input jack at the rear of the signal electronics tray.

c. Set the oscillator to the upper bandedge at the standard record level (see Tables 8A-1 and 8A-2).



INPUT IMPEDANCE	INPUT LEVEL RANGE V RMS		
	0.25 TO 1.5	1 TO 5	3.5 TO 20
75 OHMS	E1 TO E2 E9 TO E10	E1 TO E2 E5 TO E6 E13 TO E14	MUST NOT EXCEED 10V E1 TO E2 E7 TO E8 E11 TO E12
1 K OHMS	E3 TO E4 E9 TO E10	E3 TO E4 E5 TO E6 E13 TO E14	E3 TO E4 E7 TO E8 E11 TO E12
20 K OHMS	E9 TO E10	E5 TO E6 E13 TO E14	E7 TO E8 E11 TO E12

Figure 8A-1. Direct Record Amplifier Jumpering

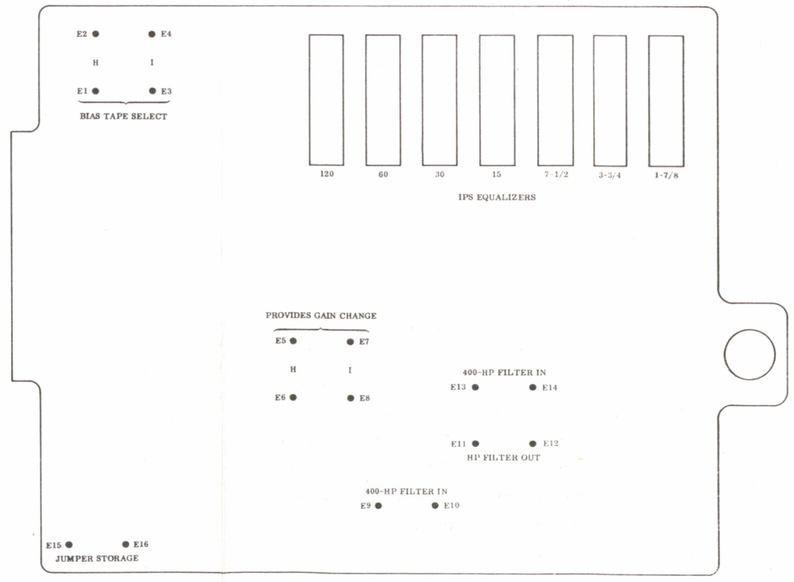


Figure 8A-2. Direct Reproduce Amplifier Jumpering

d. Press the POWER pushbutton to turn power on.

e. Switch to the tape speed being checked and initiate the record forward mode.

f. Adjust channel 1 BIAS control for maximum output. Continue to increase the setting (cw) until the output drops 2 dB for 2.0 wideband direct and 1 dB for 1.5 wideband direct. See Figures 8A-7 and 8A-8.

g. Press the STOP pushbutton.

h. Repeat steps b through g for the remaining channels using the appropriate adjustments.

RECORD LEVEL AND SECOND HARMONIC LEVEL ADJUSTMENTS

To adjust the record level, proceed as follows:

a. Connect the oscillator to the channel 1 input jack at the rear of the signal electronics tray.

b. Set oscillator to the record level set frequency for the tape speed being checked at the standard record level (see Tables 8A-1 and 8A-2).

c. Switch to the tape speed being checked and initiate the forward record mode.

d. Set REC LEVEL potentiometer R27 to its mid-scale position. Check the reproduce output signcal for second harmonic distortion and adjust the appropriate second harmonic ($2f_o$) control on the headdriver for minimum second harmonic distortion. (See Figures 8A-5, 8A-7 and 8A-8).

e. Check third harmonic distortion and adjust R27 for 1% third harmonic distortion. The wave analyzer, tuned to the third harmonic of the reproduced signal, should read -40 dB relative to the fundamental (± correction for any gain difference between the fundamental and third harmonic component).

f. Remeasure second harmonic distortion. It should now be at least -46 dB from the reference level. Readjust $2f_o$ control slightly to minimize second order harmonic distortion, if necessary.

NOTE

If the $2f_o$ control was more than slightly readjusted, check the bias level and 3rd order harmonic distortion again.

g. Press the STOP pushbutton.

h. Repeat steps a through g for the remaining channels using the appropriate REC LEVEL and $2f_o$ controls.

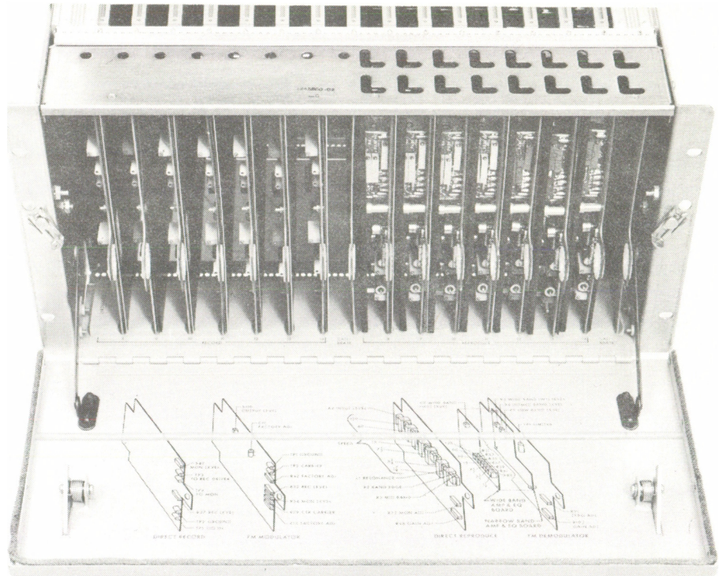


Figure 8A-3. Signal Electronics Tray - Showing Signal Electronics Adjustment Callouts

Table 8A-1. 2.0 Wideband Setup Frequencies

SPEED	REPRO REF FREQ	PEAK FREQ	LOW BAND-EDGE	UPPER BAND-EDGE	RECORD LEVEL SET FREQ	.9 UPPER BAND-EDGE
120	200 kHz	300 kHz	400 Hz	2 MHz	200 kHz	1.8 MHz
60	100 kHz	150 kHz	400 Hz	1 MHz	100 kHz	900 kHz
30	50 kHz	80 kHz	400 Hz	500 kHz	50 kHz	450 kHz
15	25 kHz	50 kHz	400 Hz	250 kHz	25.0 kHz	225 kHz
7-1/2	12.5 kHz	22 kHz	400 Hz	125 kHz	12.5 kHz	112.5 kHz
3-3/4	6.25 kHz	10 kHz	400 Hz	62.5 kHz	6.25 kHz	56.25 kHz
1-7/8	3.125 kHz	5 kHz	400 Hz	31.25 kHz	3.125 kHz	28.125 kHz

Table 8A-2. 1.5 Wideband Setup Frequencies

SPEED	REPRO REF FREQUENCY	PEAK FREQUENCY	LOW BANDEDGE	UPPER BANDEDGE	RECORD LEVEL SET FREQUENCY
120	150 kHz	250 kHz	400 Hz	1.5 MHz	150 kHz
60	75 kHz	150 kHz	400 Hz	750 kHz	75 kHz
30	37.5 kHz	75 kHz	400 Hz	375 kHz	37.5 kHz
15	18.7 kHz	36 kHz	400 Hz	187 kHz	18.7 kHz
7-1/2	9.3 kHz	20 kHz	400 Hz	93 kHz	9.3 kHz
3-3/4	4.6 kHz	10 kHz	400 Hz	46 kHz	4.6 kHz
1-7/8	2.3 kHz	5 kHz	400 Hz	23 kHz	2.3 kHz

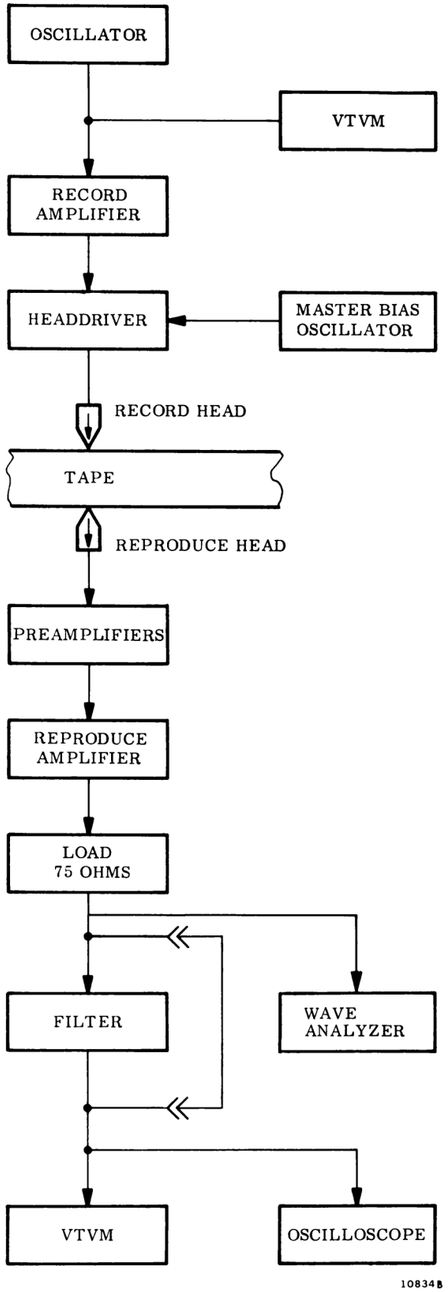


Figure 8A-4. Wideband Direct Signal Electronics Test Setup

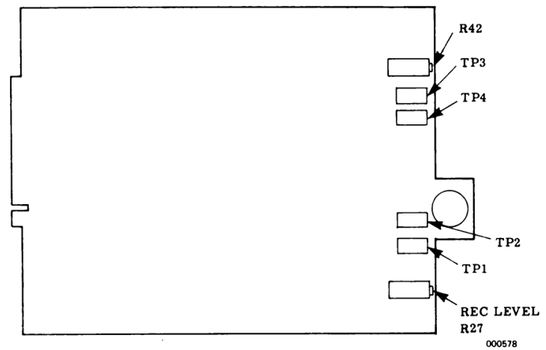


Figure 8A-5. Direct Record Amplifier Adjustments

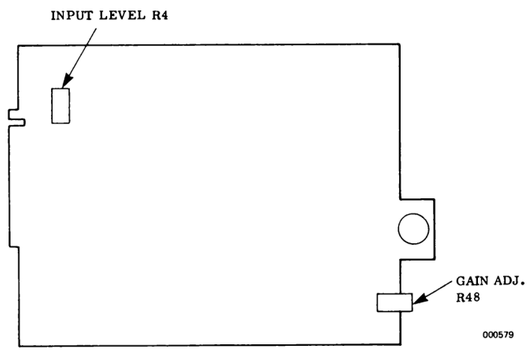


Figure 8A-6. Direct Reproduce Amplifier Adjustments

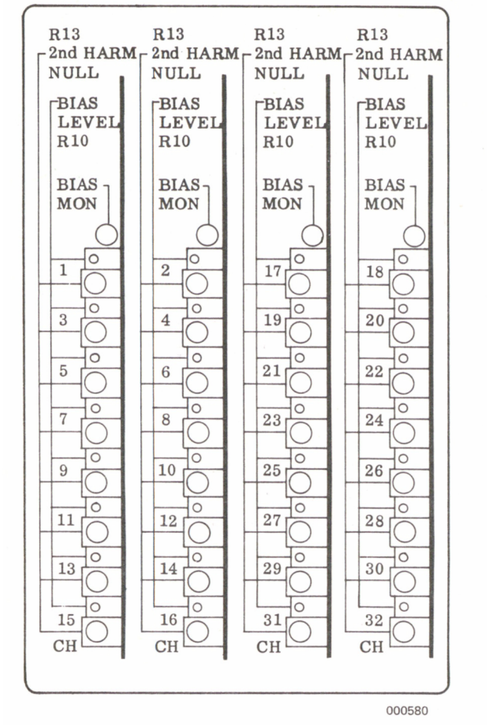


Figure 8A-7. Headdriver Controls

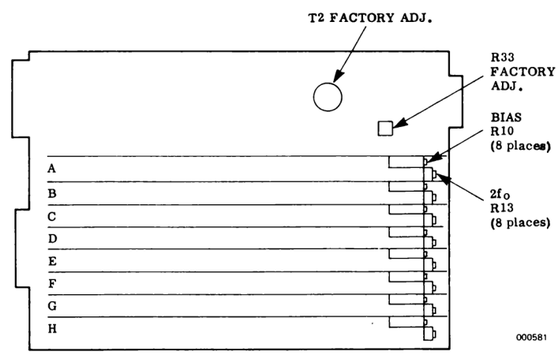


Figure 8A-8. Headdriver Assembly Adjustments

HEADDRIVER-BIAS AMPLIFIER SECTION-FACTORY ADJUSTMENTS

These adjustments are normally considered factory adjustments. They should not require field adjustment unless components have been replaced in the headdriver pwa.

a. Primary output transformer T2. This transformer is part of the output stage of the bias amplifier. It forms a resonant circuit tuned to 7.7 MHz. The inductance of transformer T2 is adjusted by a tuning slug for minimum dc current drain from the +18V dc power supply. It is a one time only factory adjustment.

b. OUTPUT ADJUSTMENT R33. R33 is in the agc circuit of the bias amplifier section of the headdriver pwa. This amplifier section provides sufficient bias current for up to eight tracks of record signal amplifiers. The OUTPUT ADJ potentiometer R33 determines the amount of agc voltage and thus the exact bias amplifier output voltage. For 2.0 and 1.5 MHz systems R33 is adjusted so that a peak-to-peak voltage measured across TP7 and TP8 (gnd) is between 20-22V p-p. The exact amount being a factor of the particular headstacks in use. Unless the record heads are being changed, it is <u>not</u> recommended that R33 be touched. (An extender board and a non-metallic, blade screwdriver will be required for this adjustment.)

REPRODUCE HEAD AZIMUTH ADJUSTMENT

To adjust the reproduce head azimuth, proceed as follows:

a. Connect the oscillator to the channel 1 input jack at the rear of the signal electronics tray.

b. Set the oscillator to the upper bandedge at the tape speed being checked at the standard record level (see Tables 8A-1 and 8A-2).

c. Switch to the tape speed being checked and initiate the forward record mode.

d. Adjust the appropriate reproduce head azimuth screw for maximum output signal. See Figure 8A-9.

e. Repeat step d for the remaining channels and make a final adjustment of head azimuth as a compromise between output signals from the various channels.

f. Press the STOP pushbutton.

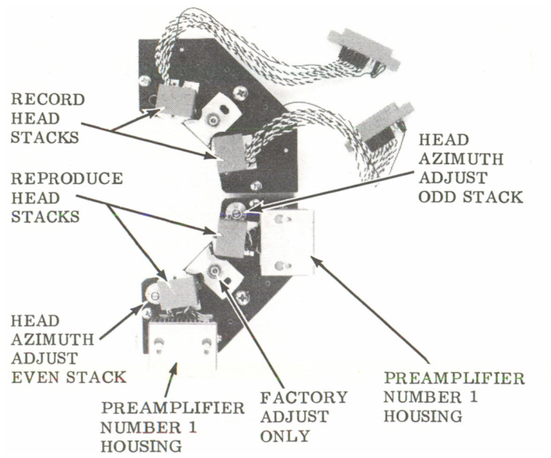


Figure 8A-9. FR3010 Record/Reproduce Heads - Showing Azimuth Adjustments

REPRODUCE LEVEL ADJUSTMENT

To adjust the reproduce level, proceed as follows:

a. Connect the oscillator to the channel 1 input jack at the rear of the signal electronics tray.

b. Set the oscillator to the peak frequency at the tape speed being checked at the standard record level (see Tables 8A-1 and 8A-2).

c. Switch to the tape speed being checked and initiate the forward record mode.

d. Turn GAIN ADJ control R48 cw to midrange position. Turn R4 until saturation or higher distortion of reproduce signal just starts (see Figure 8A-10) then back off R4 until signal is reduced 3 to 6 dB.

e. Set the oscillator to 0.02 of the upper bandedge frequency and adjust R48 OUTPUT LEVEL control so that the reproduce level is the standard record level - 1V rms.

f. Press the STOP pushbutton.

g. Repeat steps a through f for the remaining channels using the appropriate INPUT LEVEL and GAIN ADJ controls.

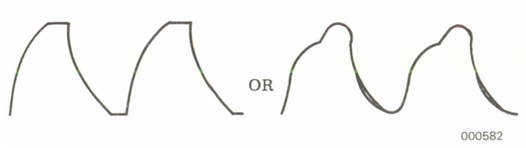


Figure 8A-10. Signal Saturating

EQUALIZER ADJUSTMENT

To adjust the equalizer, proceed as follows:

a. Connect the oscillator to the channel 1 input jack at the rear of the signal electronics tray.

b. Switch to the tape speed being checked and initiate the forward record mode.

c. Set the oscillator to the record level set frequency for the tape speed being checked at the standard record level and adjust peak level control R3 for the standard output level - 1V rms at the reproduce output. See Figure 8A-11.

d. For 1.5 wideband system proceed to step e. For 2.0 wideband systems proceed to step j.

e. Set the oscillator to the upper bandedge frequency at the standard record level.

f. Adjust upper bandedge resonance inductor L1 for maximum reproduce output.

g. Adjust bandedge level control R2, for a reproduce output that is -2 dB to -3 dB below the standard output level.

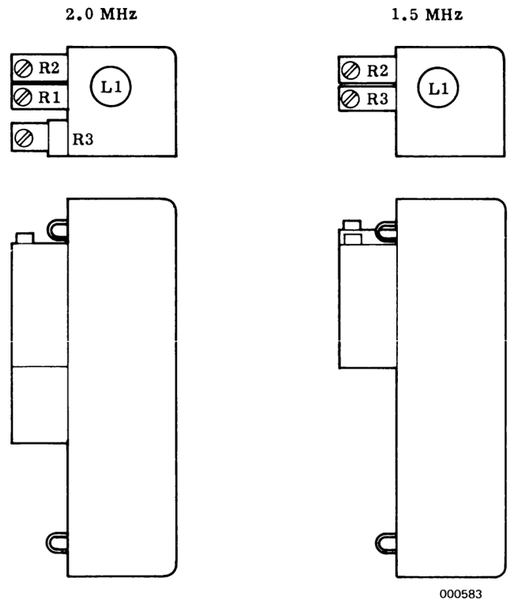


Figure 8A-11. Direct Equalizer Adjustments

h. Sweep the oscillator between the low bandedge frequency and the upper bandedge frequency. Response should be within ±3 dB from the reproduce reference frequency. Peaks or valleys in the response curve that exceed ±3 dB from the reproduce reference frequency may be attenuated by adjusting L1. If L1 is adjusted, R2 must be readjusted as in step g.

NOTE

Resonance control L1 should never be adjusted more than a few turns from the setting obtained in step f.

i. Press the STOP pushbutton. Proceed to step q.

j. Set the oscillator to 0.9 upper bandedge at tape speed being checked at the standard record level.

k. Adjust L1 on the equalizer for maximum output. (R1 and R2 must not be fully ccw.)

l. Adjust R1 on the equalizer for the standard output level out of the reproduce amplifier.

m. Set the oscillator to upper bandedge and adjust R2 on the equalizer for a reproduce output of -2 dB below the standard output level.

n. Sweep the oscillator between the low bandedge and upper bandedge. If the response is not within ±3 dB from the reproduce reference frequency, a slight adjustment of L1 and R1 may be necessary. If L1 is readjusted, R2 must be readjusted as in step m above.

o. Further adjustment to aid response may be achieved with peak level control R3.

p. Press the STOP pushbutton.

q. Repeat steps b to p for all other tape speeds.

r. Repeat steps a to q for the remaining channels.

GENERAL

DEFINITIONS - DIRECT

OPERATING INPUT LEVEL. Any data input level to the record amplifier, which falls between the minimum and maximum levels listed on the specification sheet, shall be known as the OPERATING INPUT LEVEL.

STANDARD RECORD LEVEL. The Record Level control is adjusted with a given input signal to produce a signal at the output of the reproduce amplifier which contains 1% third order harmonic distortion. This input signal shall be known as the STANDARD RECORD LEVEL signal. (This is similar to "Normal Record Level" as defined in IRIG 106-37.)

STANDARD OUTPUT LEVEL. The Reproduce Output Level control is normally adjusted to produce an output signal amplitude of 1 volt rms, as measured across the proper terminating impedance, when reproducing a STANDARD RECORD LEVEL signal. This signal shall be known as the STANDARD OUTPUT LEVEL signal. (Values other than 1 volt rms may be used, but degradation in signal-to-noise or distortion may result.)

OPERATING INPUT LEVEL UNKNOWN. Equipment is normally adjusted at the factory utilizing 1 volt rms for the STANDARD RECORD LEVEL. On site alignment may be made with a test signal generator producing either the sites' preferred STANDARD RECORD LEVEL or the factory STANDARD RECORD LEVEL.

OPTIONAL RECORD LEVEL MONITORING SYSTEM

An optional record level monitoring system, comprising a series of level meters or oscilloscopes, one for each channel, is available for correct adjustment of the electronics to different levels of data signals. After calibration of the monitors at the 1% third harmonic distortion level, this monitoring provision allows the record amplifier to be adjusted for correctly recording signals of various levels by means of the channel gain control located on the front of the appropriate record amplifier module. Detailed information and schematics of the electronic assemblies are included in the FR3010 Signal Electronics manual 1802855.

INTERCHANGEABLE PWA'S

Interchangeable modular printed circuit cards are used throughout the FR-3010 system. Interchange of these modules should not be made after system alignment unless the channels affected by the interchange are realigned.

ADJUSTMENTS

PREADJUSTMENT FUNCTIONS

Perform the following prealignment functions:

a. Place the jumpers on the direct record and reproduce amplifiers in the following configuration:

   1. Set record jumpers to match desired input impedance and input level range as per Figure 8A-12.

   2. Reproduce E1-E2 selects the correct bias trap.

   3. Reproduce E7-E8 selects gain for Intermediate Band operation.

   4. Reproduce E11-E12 completes Intermediate Band input (bypasses 400 Hz high pass filter).

b. Set the INPUT LEVEL control R4 and the GAIN ADJ R48 (on the direct reproduce amplifier) in the midscale position. (See Figure 8-8 for location of R4 and R48.)

c. Terminate the reproduce amplifiers with 75Ω.

d. Set R27 REC LEVEL, on the record amplifier, at midrange, (see Figures 8A-14 and 8A-17).

e. Using a convenient input signal reference level perform the following adjustments in the order listed:

   1. Bias - followed by

   2. Record level and second harmonic level - followed by

   3. Reproduce level - followed by

   4. Equalizer adjustments

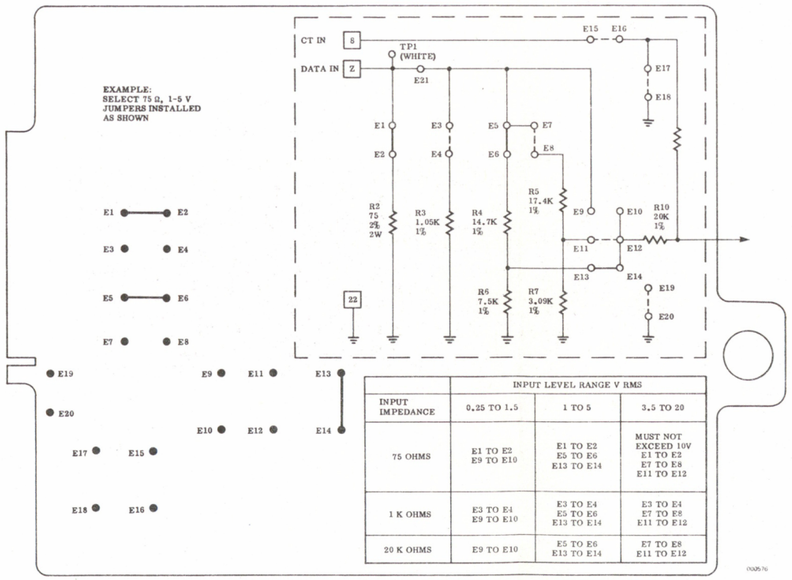


Figure 8A-12. Intermediate Band Direct Record Amplifier Jumpering

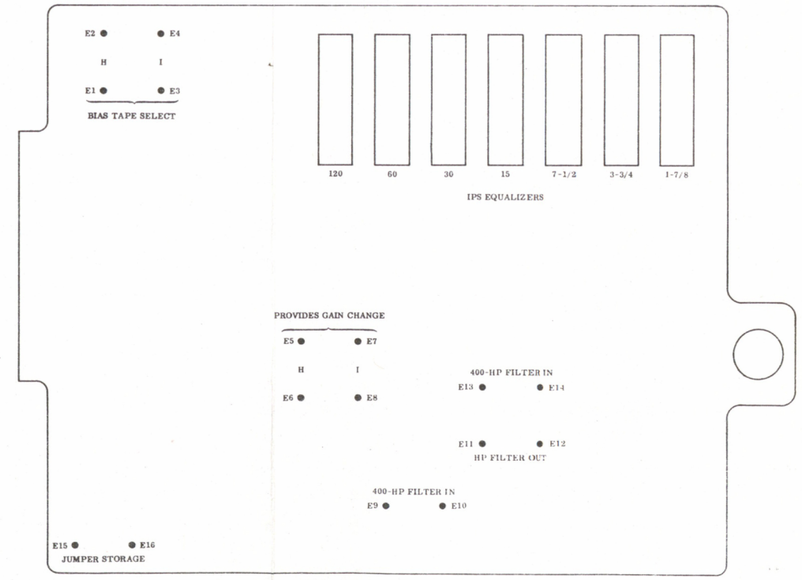


Figure 8A-13. Intermediate Band Direct Reproduce Amplifier Jumpering

BIAS LEVEL ADJUSTMENT

To adjust the bias level, proceed as follows:

a. Set up the test equipment as shown in Figure 8A-15 with the filter disconnected (jumpered).

b. Connect the oscillator to the channel 1 input jack at the rear of the signal electronics tray. Connect channel 1 reproduce amplifier to test equipment.

c. Set the oscillator to upper bandedge frequency at the standard record level. Refer to Table 8A-3.

d. Press the POWER pushbutton to turn power on.

e. Switch to the tape speed being checked and initiate the forward record mode.

f. Adjust channel 1 BIAS potentiometer for maximum signal output. Continue to adjust in a cw direction until output drops 3 dB. See Figures 8A-18 and 8A-19.

g. Press the STOP pushbutton.

h. Repeat steps b through g for the remaining channels, using the appropriate BIAS adjustments.

RECORD LEVEL AND SECOND HARMONIC LEVEL ADJUSTMENTS

To adjust the record and second harmonic levels, proceed as follows:

a. Connect the oscillator to the channel 1 input jack at the rear of the signal electronics tray.

b. Set the oscillator to the record level set frequency for the tape speed being checked at the standard record level. (See Table 8A-3).

c. Switch to the tape speed being checked and initiate the forward record mode.

d. Set REC LEVEL potentiometer R27 to its midscale position. Check the reproduced output signal for second harmonic distortion and adjust the appropriate $2f_o$ control on the headdriver for minimum second harmonic distortion. See Figures 8A-16, 8A-17 and 8A-19.

e. Check third harmonic distortion and adjust R27 for 1% third harmonic distortion. The wave analyzer, tuned to the third harmonic of the reproduced signal, should read -40 dB relative to the fundamental (±correction for any gain difference between the fundamental and third harmonic component).

f. Remeasure second harmonic distortion. It should now be at least -46 dB from the reference level. Readjust $2f_o$ control slightly to minimize second order harmonic distortion if necessary.

NOTE

If the $2f_o$ control was more than slightly re-adjusted check bias and third order harmonic distortion again.

Table 8A-3. Intermediate Band Setup Frequencies

SPEED	REPRO REF FREQUENCY	PEAK FREQUENCY	LOW BANDEDGE	UPPER BANDEDGE	RECORD LEVEL SET FREQUENCY
120	60 kHz	150 kHz	300 Hz	600 kHz	60 kHz
60	30 kHz	75 kHz	300 Hz	300 kHz	30 kHz
30	15 kHz	38 kHz	150 Hz	150 kHz	15 kHz
15	7.5 kHz	19 kHz	100 Hz	75 kHz	7.5 kHz
7-1/2	3.75 kHz	9 kHz	100 Hz	38 kHz	3.75 kHz
3-3/4	1.875 kHz	4.5 kHz	100 Hz	19 kHz	1.875 kHz
1-7/8	937 Hz	2.5 kHz	100 Hz	10 kHz	937 Hz

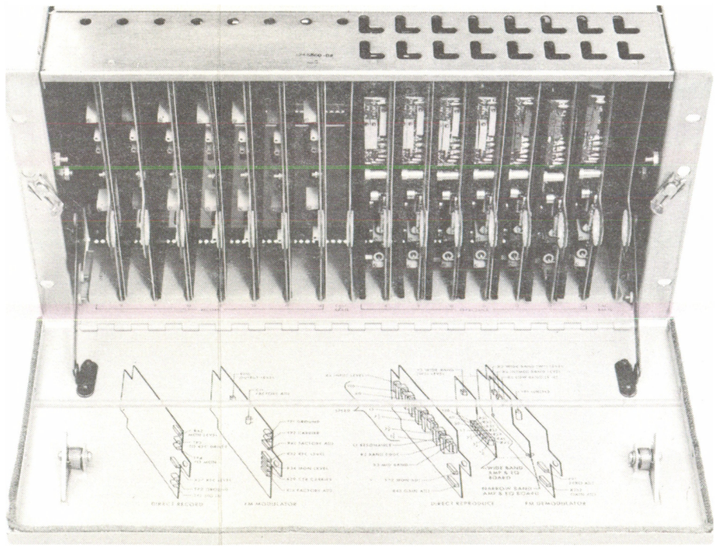


Figure 8A-14. Signal Electronics Tray - Showing Signal Electronics Adjustment Callouts

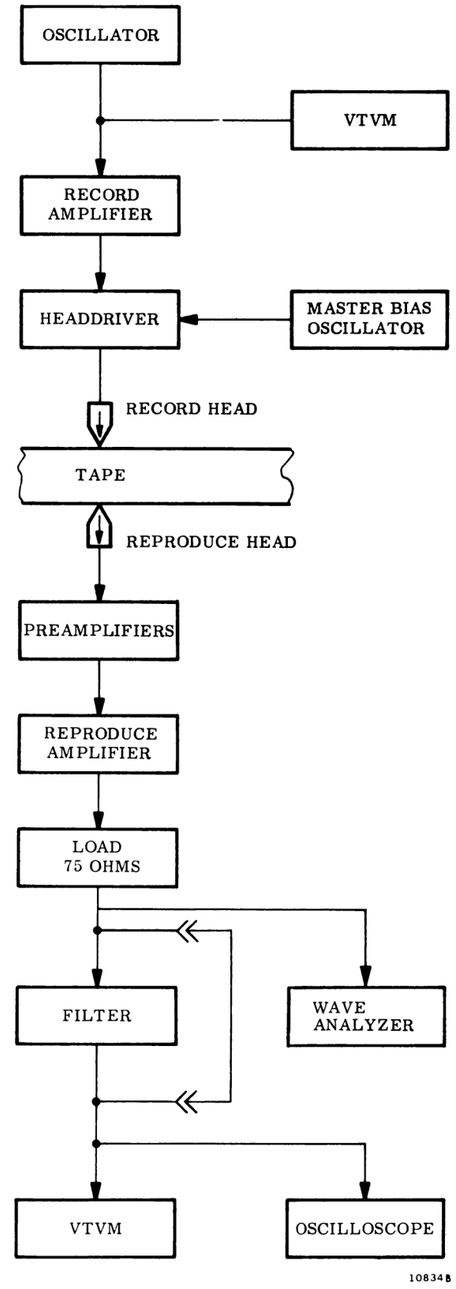


Figure 8A-15. Intermediate Band Direct Electronics Test Setup

g. Press the STOP pushbutton.

h. Repeat steps a through g for the remaining channels using the appropriate REC LEVEL and $2f_o$ controls.

HEADDRIVER-BIAS AMPLIFIER SECTION-FACTORY ADJUSTMENTS

These adjustments are normally considered factory adjustments. They should not require field adjustment unless components have been replaced in the headdriver pwa.

a. Primary output transformer T2. This transformer is part of the output stage of the bias amplifier. It forms a resonant circuit tuned to 7.7 MHz. The inductance of transformer T2 is adjusted by a tuning slug for minimum dc current drain from the +18V dc power supply. It is a one time only factory adjustment.

b. OUTPUT ADJUSTMENT R33. R33 is in the agc circuit of the bias amplifier section of the headdriver pwa. This amplifier section provides sufficient bias current for up to eight tracks of record signal amplifiers. The OUTPUT ADJ potentiometer R33 determines the amount of agc voltage and thus the exact bias amplifier output voltage. For 2.0 and 1.5 MHz systems R33 is adjusted so that a peak-to-peak voltage measured across TP7 and TP8 (gnd) is between 20-22V p-p. The exact amount being a factor of the particular headstacks in use. Unless the record heads are being changed, it is not recommended that R33 be touched. (An extender board and a non-metallic, blade screwdriver will be required for this adjustment.)

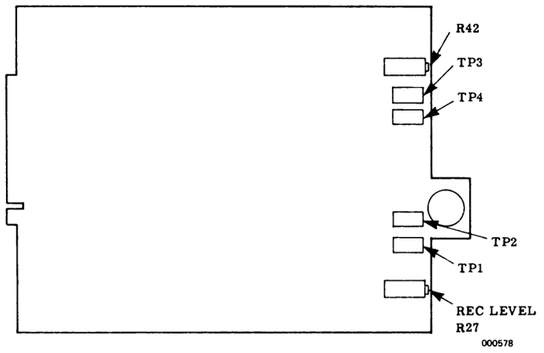


Figure 8A-16. Direct Record Amplifier Adjustments

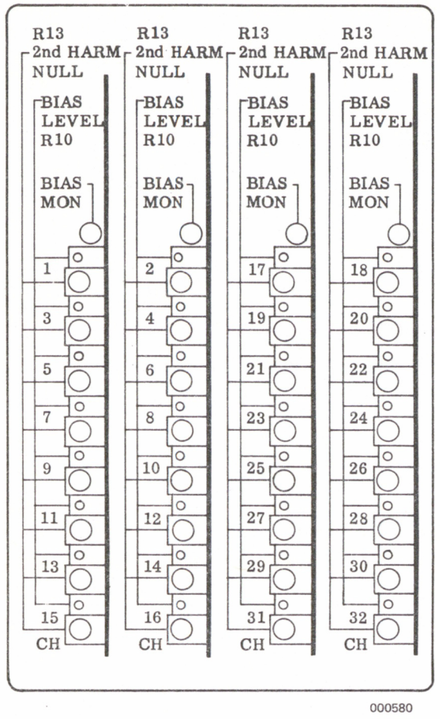


Figure 8A-18. Headdriver Controls

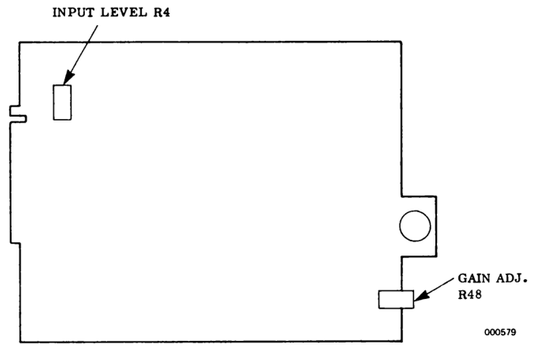


Figure 8A-17. Direct Reproduce Amplifier Adjustments

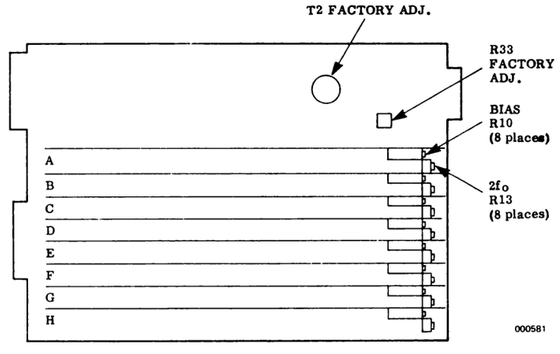


Figure 8A-19. Headdriver Assembly Adjustments

REPRODUCE LEVEL ADJUSTMENT

To adjust the reproduce level, proceed as follows:

a. Connect the oscillator to the channel 1 input jack at the rear of the signal electronics tray.

b. Set the oscillator to peak frequency for the tape speed being checked at the standard record level (see Table 8A-3).

c. Switch to the tape speed being checked and initiate the forward record mode.

d. Adjust the setting of INPUT LEVEL control R4 to a point where slight distortion starts to appear on the positive half cycle. It should be noted that at tape speeds of 60 ips and below, INPUT LEVEL control R4 will probably be at maximum.

e. Set the oscillator to .02 upper bandedge frequency at the tape speed being checked at the standard record level.

f. Adjust GAIN ADJUSTMENT R48 so that the reproduce level is the standard output level - 1V rms.

g. Press the STOP pushbutton.

h. Repeat steps a through g for the remaining channels using the appropriate INPUT LEVEL and GAIN ADJUSTMENT controls.

EQUALIZER ADJUSTMENT

To adjust the equalizer, proceed as follows:

a. Connect the oscillator to the channel 1 input jack at the rear of the signal electronics tray.

b. Switch to the tape speed being checked and initiate the forward record mode.

c. Set the oscillator to peak frequency for the tape speed being checked at the operating input level and adjust the peak level control R3 for the standard record level - 1V rms. (See Table 8A-3 and Figure 8A-20).

d. Set the oscillator to upper bandedge frequency at the standard record level

e. Set upper bandedge control R2 fully clockwise.

f. Adjust bandedge resonance control L1 for maximum output level.

g. Readjust bandedge level control R2 for an output level of -2 to -3 dB below the standard output level.

h. Check the response between reproduce reference frequency and bandedge frequency; if it is within ±3 dB of the standard output level no further alignment is necessary.

i. Peaks and/or valleys near upper bandedge greater than ±3 dB may be attenuated by adjusting L1. However, bandedge level control R2 must be readjusted, as in step g, if L1 is moved.

NOTE

Resonance control L1 should never be adjusted more than a few turns from the setting obtained in step f.

j. Press the STOP pushbutton.

k. Repeat steps a to j for all other tape speeds.

l. Repeat steps a to k for the remaining channels.

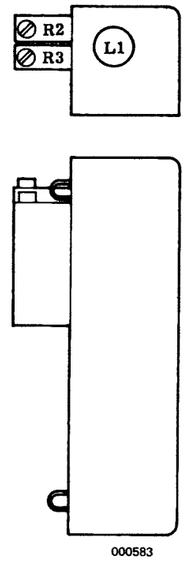


Figure 8A-20. Intermediate Band Direct Equalizer Adjustments

SECTION 8B FM ADJUSTMENT PROCEDURES

GENERAL

Interchangeable modular printed circuit cards are used throughout the FM Signal Electronics system. Interchange of these modules should not be made after system alignment unless the channels affected by the interchange are realigned.

Before proceeding with the alignment, ensure that:

a. The heads are degaussed.

b. Fully degaussed tape is loaded for forward operation.

c. The electronic modules are correctly set for the desired bandwidth.

d. The fm modulator is correctly jumpered for input sensitivity and impedance (refer to Tables 8B-1 and 8B-2).

e. The fm demodulator is correctly jumpered (refer to Tables 8B-3 and 8B-4).

f. If the fm calibrator is to be used, follow the procedures as instructed in the calibrator manual, Ampex 1801933, and make certain that the REC TEST switch S7 on the inner test panel is in the OFF position and do not initiate the reproduce mode when calibrating the demodulator.

The calibration procedures for the fm record/reproduce electronics wideband group II utilizes setup frequencies listed in Table 8B-5.

Adjustment controls for the fm record/reproduce signal electronics system are shown on the inside of the electronics tray front cover door. The second harmonic ($2f_o$) and BIAS controls are located on the headdriver card. They are accessible from the front of the transport, beneath the head cover plate.

DEFINITIONS

STANDARD INPUT SIGNAL

A standard input signal is applied to the fm record amplifier for test purposes. It is defined as: that input signal level which deviates the fm modulator from its center carrier frequency (ccf) ±30% for WII bipolar operation. If the fm modulation is configured for unipolar operation the fm carrier frequency will be deviated positive or negative 60% for WII operation.

The fm calibration procedure given in this chapter will use the following input voltage levels for test purposes.

a. A standard dc input at positive or negative 1.414V.

b. A standard ac input at 1V rms.

The fm modulator may be calibrated for other input signal levels if desired. Fm record input attenuator jumpering must be configured to accept the maximum peak voltage at its input.

STANDARD OUTPUT LEVEL

The reproduce output level control is normally adjusted to produce an output signal amplitude of 1V rms as measured across the proper terminating impedance, when reproducing a STANDARD INPUT SIGNAL LEVEL. This signal is known as the STANDARD OUTPUT LEVEL. (Values other than 1 volt rms may be used, but degradation in signal-to-noise or distortion may result.)

HIGHEST TAPE SPEED AVAILABLE

Defined as: the highest tape speed for which data filters are available. It will be referred to as "the highest tape speed available" in the alignment procedures.

LOWEST TAPE SPEED AVAILABLE

Defined as: the lowest tape speed for which data filters are available. It will be referred to as "the lowest tape speed available" in the alignment procedures.

Table 8B-1. Modulator Jumper Positions for Wideband (W2)

CIRCUIT INVOLVED	ACTION	JUMPER	REMARKS
Low-pass filter, L5-L8, C45-C50	Insert	IN to W2	Connects carrier input to low-pass filter
(Two jumpers per bandwidth group, one IN, one OUT)	Insert	OUT to W2	Connects low-pass filter to R110 (DRIVE ADJ)
NORMAL/DUB output (factory set to normal)	Insert	NORMAL	Connects carrier to output amplifier
Frequency divider output	Insert	IN to W2	Selects correct fm carrier for W2 operation
Controlled multivibrator (factory set to normal)	Insert	NORMAL	Enables controlled multivibrator circuit (Q19, Q20)
Center carrier offset (normally set to center at factory)	Insert	CENTER	Configures basic fm modulator for bi-polar operation
Center carrier frequency adjustment	Set	R29 (CCF ADJ) Adjusted for the CCF at TP2 (yellow) with no data input. (This procedure is carrier out during alignment of the fm system electronics. see Table 8-9).	Calibrates basic modulator for wideband (W2) operation C11. C11 has been factory adjusted with R29 6 turns ccw from top
Center carrier offset* (0V - 1V peak minimum	Insert	W2 to HI	Offsets carrier frequency +30%, for 0 to negative unipolar data input
Center carrier offset* (0V - 1V peak minimum)	Insert	W2 to LO	Offsets carrier frequency -30%, for 0 to positive unipolar data input

*NOTE

If unipolar operation is required (provided on special order only) the center carrier offset jumper must be in place. See Figure 8B-1.

Table 8B-2. Impedance Selection for Wideband (W2) Operation

INPUT ** IMPEDANCE	INPUT VOLTAGE	ACTION	JUMPER	REMARKS
1 kΩ	0.5V to 2.5V peak	Insert Insert Remove	W2-1K JPR-4 Remaining jumpers	Selects 1 kΩ impedance Attenuation 1:1 Disconnects unused attenuators
1 kΩ	1.6V to 7.9V peak	Insert Insert Remove	W2-1K JPR-5 Remaining jumpers	Selects 1 kΩ impedance Attenuator $\sqrt{10:1}$ Disconnect unused attenuators
1 kΩ	5.0V to 25V peak	Insert Insert Remove	W2-1K JPR-6 Remaining jumpers	Selects 1 kΩ impedance Attenuation 10:1 Disconnects unused attenuators
75Ω	0.5V to 2.5V peak	Insert Insert Insert Remove	W2-1K 75Ω JPR-4 Remaining jumpers	Selects 1 kΩ impedance Reduces Z to 75Ω Attenuation 1:1 Disconnects unused attenuators
75Ω	1.6V to 7.9V peak	Insert Insert Insert Remove	W2-1K 75Ω JPR-5 Remaining jumpers	Selects 1 kΩ impedance Reduces Z to 75Ω Attenuation $\sqrt{10:1}$ Disconnects unused attenuators
75Ω	5.0V to 10V peak	Insert Insert Insert Remove	W2-1K 75Ω JPR-6 Remaining jumpers	Selects 1 kΩ impedance Reduces Z to 75Ω Attenuation 10:1 Disconnects unused attenuators

**NOTE

The 20,000 ohm input impedance is not recommended for W2 operation. Shunt capacitance in the 20,000 ohm attenuator causes a reduction in signal level at the high end of the data passband (high end rolloff).

CAUTION

DO NOT EXCEED 10V PEAK (7V RMS) SIGNAL INPUT WHEN USING AN INPUT IMPEDANCE OF 75 OHMS. DAMAGE TO THE 75 OHM IMPEDANCE MATCHING RESISTORS (R1, R2) WILL RESULT.

Table 8B-3. Demodulator Jumper Positions for Wideband (W2) ***

CIRCUIT INVOLVED	ACTION	JUMPER	REMARKS
Countdown multivibrator	Insert	W2	Frequency adjustment of multivibrator
Dc offset	Insert	W2	Dc zero balance resistance set for W2

***NOTE

See Figure 8B-2

Table 8B-4. FM Demodulator Subassemblies Plug-In and Jumper Positions ***

CIRCUIT INVOLVED	ACTION	PLUG-IN TO JUMPER	REMARKS
Bandwidth select plug P1 (S1)	Position in WII	S1	Selects bandwidth components for W2
Filter group select plug P2 (S2)	Position in WII	S2	Selects filters for W2
Wideband input amplifier and equalizer assembly 1801595	Plug-in	- - -	Connect E103 to the edge pin connectors carrying the speed switching lines
Low-pass filter assemblies 1801593-01 through -07	Plug-in in speed position	- - -	Provides filtering for individual speeds
Carrier filter assembly 1801616	Plug-in	- - -	Provides carrier rejection for WII bandwidth

FM MODULATOR ALIGNMENT

There are two methods of aligning a FM modulator:

a. Using standard test equipment.

b. Using a calibrated FM demodulator

FM MODULATOR ALIGNMENT USING STANDARD TEST EQUIPMENT

To align the fm modulator, using standard test equipment proceed as follows:

NOTE

Allow 15 minutes warmup before making final adjustments

a. Connect test equipment as shown in Figure 8B-3.

b. Connect the electronic counter and the oscilloscope to the fm modulator output (TP2).

c. Ground the fm modulator input.

d. Turn system power on. Set the transport speed selector to the highest tape speed available (do not move tape).

e. Adjust carrier level control R110, for 2V p-p at TP2. (This is a preliminary adjustment).

f. Adjust center carrier frequency control R29, for center carrier frequency (±0.1%). See Table 8B-5.

g. Remove the ground from the fm modulator input and apply a positive standard dc input (±1.414V).

h. Adjust deviation level control R32 for maximum positive deviation frequency (+30% for WII, refer to Table 8B-5.

i. Apply the negative standard dc input (-1.414V) and measure maximum negative deviation frequency (-30% for WII, refer to Table 8B-5).

j. Optimize linearity, (full band deviation tolerance ±0.5%, refer to Table 8B-5) by readjusting R32 slightly if necessary.

k. Repeat steps a through j for all other cards to be aligned.

l. Turn system power off. Remove the test equipment from the fm modulator.

m. This completes alignment of the carrier frequencies of the fm modulator, for all speeds. Proceed to bias level adjustments.

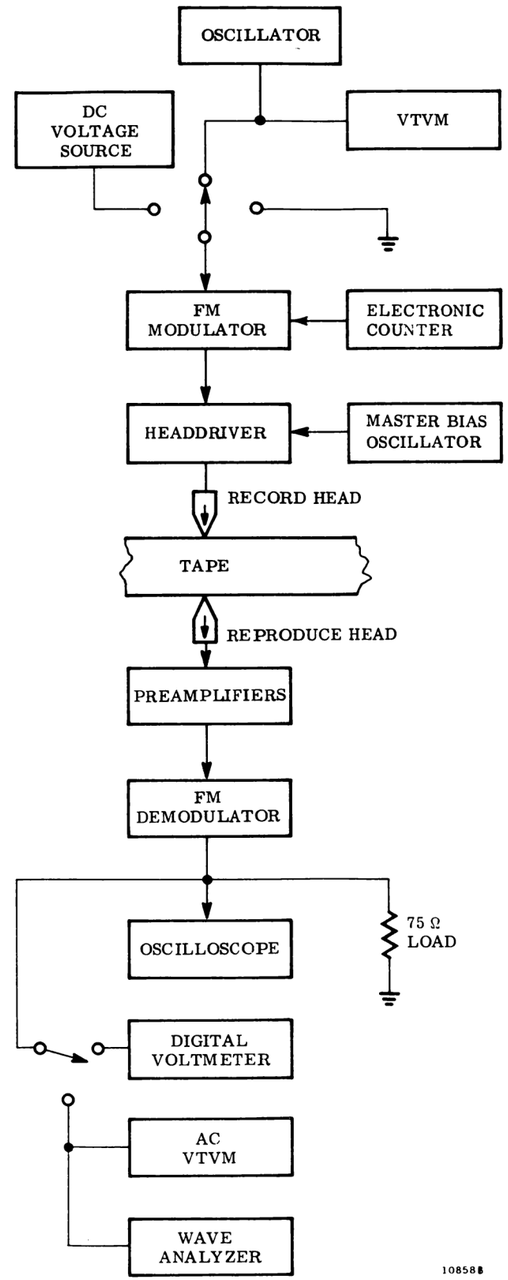


Figure 8B-3. FM Signal Electronics Test Setup

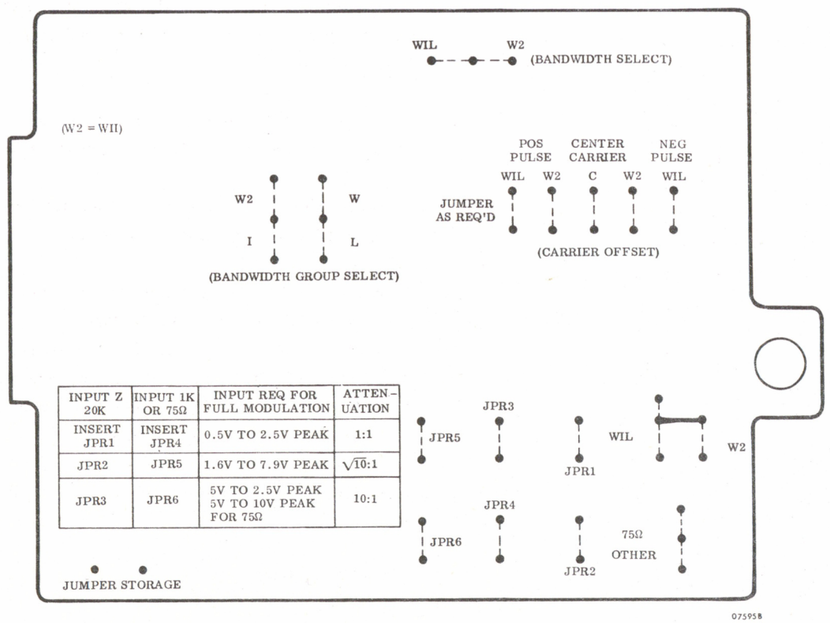


Figure 8B-1. FM Modulator - Location of Jumper Positions

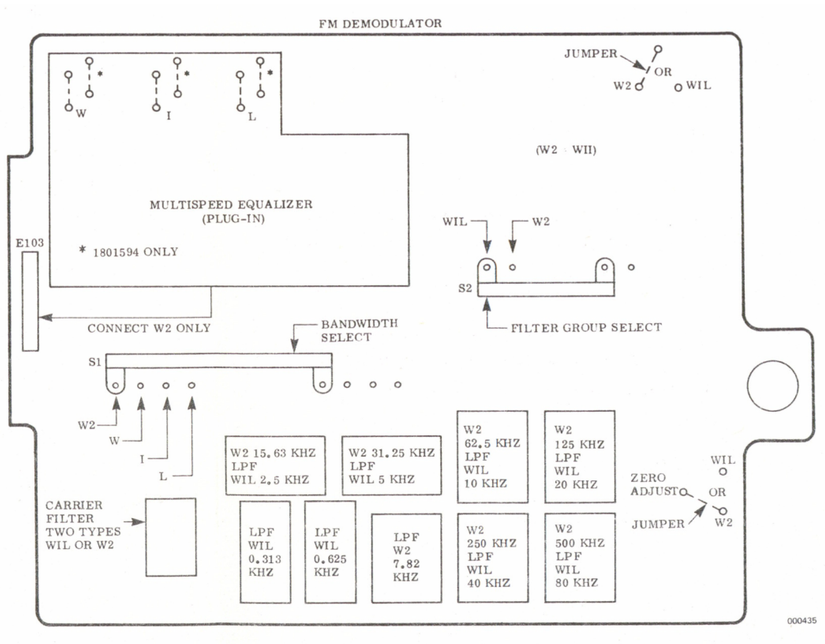


Figure 8B-2. FM Demodulator - Configuration of Bandwith Components

Table 8B-5. Wideband Group II Frequencies.

TAPE SPEED (ips)	CENTER CARRIER	CENTER CARRIER TOLERANCE (±0.1%)	MAX + DEVIATION +30%	MAX - DEVIATION -30%	FULL BAND DEVIATION	FULL BAND TOLERANCE (±0.5%)	MODULATION FREQUENCY
120	900 kHz	±900 Hz	1170 kHz	630 kHz	540 kHz	±2.7 kHz	Dc - 500 kHz
60	450 kHz	±450 Hz	585 kHz	315 kHz	270 kHz	±1.35 kHz	Dc - 250 kHz
30	225 kHz	±225 Hz	292 kHz	157 kHz	135 kHz	±675 Hz	Dc - 125 kHz
15	112.5 kHz	±110 Hz	146 kHz	78.75 kHz	67.25 kHz	±337.5 Hz	Dc - 62.5 kHz
7-1/2	56.25 kHz	±56 Hz	73.125 kHz	39.375 kHz	33.75 kHz	±168.8 Hz	Dc - 31.25 kHz
3-3/4	28.125 kHz	±28 Hz	36.562 kHz	10.688 kHz	16.87 kHz	±84.4 Hz	Dc - 15.6 kHz
1-7/8	14.0625 kHz	±14 Hz	18.281 kHz	9.844 kHz	8.43 kHz	±42.2 Hz	Dc - 7.8 kHz

FM MODULATOR ALIGNMENT USING A CALIBRATED FM DEMODULATOR

To align the fm modulator using a calibrated fm demodulator, proceed as follows:

a. Patch test point TP2 of the fm modulator to test point TP7 of the calibrated fm demodulator.

b. Connect the equipment as shown in Figure 8B-3.

c. Short the input of the fm modulator to ground. Turn system and transport power on.

d. Place the RECORD TEST switch in the ON position (switch S7 on the power and servo unit).

e. Adjust the center carrier frequency control R29 on the fm modulator for a zero reading on the digital voltmeter at the fm demodulator output.

f. Remove the short and apply a positive standard dc input of +1.414V to the input of the fm modulator.

g. Adjust the deviation level control R32 on the fm modulator for a reading of +1.414V dc at the output of the fm demodulator.

h. Apply a negative standard dc input signal of -1.414V to the input of the fm modulator and optimize the deviation level control R32 for the best linearity between step g and h.

i. Repeat steps a through h for the other fm modulators using the same calibrated fm demodulator. Proceed to the bias level adjustments.

BIAS LEVEL ADJUSTMENT

Adjust the bias level as follows:

a. Turn system power off. Connect the equipment as shown in Figure 8B-3.

b. Set the head normalizing potentiometer R2 on the fm demodulator equalizer plug in to mid scale.

c. Connect a positive standard dc input of +1.414V dc to the input of the modulator.

d. Connect the oscilloscope to the fm demodulator equalizer output, at TP1. Use a low capacitance (10:1) oscilloscope test probe. Turn system and transport power on.

e. Place the transport in the forward record mode at the highest tape speed to be checked.

f. Observe the output of the fm demodulator at TP1 on the oscilloscope. Adjust the ac BIAS potentiometer (on the headdriver) for maximum output at test point TP1. Rotate the reproduce head azimuth adjustment for maximum output at TP1. If clipping or distortion occurs, lower the modulator drive (R110) until clipping is eliminated, readjust the BIAS potentiometer.

g. Apply a standard ac input signal - 1V rms to the fm modulator at a frequency of 0.1 of the maximum modulation frequency (see Table 8B-5).

h. Readjust the head normalizing potentiometer R2 for a maximum signal at TP1 short of clipping and distortion, but not in excess of 1V p-p.

i. Repeat steps a through h for each channel of electronics.

j. Press the transport STOP pushbutton. Disconnect the oscilloscope from the last fm demodulator used.

FM DEMODULATOR ALIGNMENTS

There are two methods of aligning an fm demodulator:

a. Using standard test equipment

b. Using a calibrated fm modulator (recommended method).

FM DEMODULATOR ADJUSTMENT USING STANDARD TEST EQUIPMENT

Adjust the demodulator as follows:

NOTE

Allow 15 minutes warmup before making final adjustment.

a. Connect test equipment as indicated in Figure 8B-3 with the oscilloscope and digital voltmeter connected to the fm demodulator output (across a 75 ohm load). Short the input to the fm modulator to ground.

b. Place a jumper between test point TP2 of the fm modulator and TP7 of the fm demodulator. Turn on the system and transport power.

c. Throw the RECORD TEST switch S7 (on the power and servo unit) to the ON position.

d. Adjust zero adjustment potentiometer R91, on the fm demodulator, for a zero voltage reading on the digital voltmeter.

e. Remove the ground from the fm modulator input and apply the positive standard dc input (+1.414V).

f. Adjust reproduce output level potentiometer R102, for +1.414V dc (on the digital voltmeter).

g. Apply the negative standard dc input (-1.414V) at the fm modulator input. Verify that the negative dc output level (-1.414V), is within limits shown on the specification sheet. If not, readjust R102 slightly and, with the positive standard input applied, repeat steps f through g.

h. Return the RECORD TEST switch S7 to the OFF position.

i. Disconnect the standard dc input voltage from the modulator and substitute a short circuit to ground at the record input.

j. Disconnect the digital voltmeter and connect an ac vtvm to the fm reproduce output (across the 75Ω load).

k. Place the transport in the forward record mode at the lowest tape speed available.

l. Adjust fm modulator carrier level control R110 for minimum noise reading on the electronic ac voltmeter (at the fm demodulator output).

m. Adjust R2 (WII band) head-normalizing potentiometer, on the equalizer board for a minimum noise reading on the ac vtvm.

NOTE

Steps l and m optimizes the WII fm system for best signal-to-noise ratio.

n. Remove the ground from the fm modulator input and apply the standard ac input. Set the frequency of the sine-wave oscillator to the one listed in Table 8B-6 for the highest tape speed available. Connect the wave analyzer to the fm demodulator output.

o. Place the transport in the forward record mode at the highest-tape speed available.

p. Set the distortion analyzer to measure the second harmonic of the test frequency fundamental.

q. Adjust the appropriate equalizer potentiometer (see Table 8B-6) for minimum second harmonic distortion.

r. Minimize the second harmonic distortion with the appropriate equalizer potentiometers at the remaining available tape speeds.

s. Press the transport STOP pushbutton.

t. If the record head second harmonic adjustment ($2f_o$) has already been made for a Direct Record/Reproduce system leave it as set for the FM system also. If the $2f_o$ adjustment has not been previously set proceed to step u.

u. Make the record head second harmonic ($2f_o$) adjustment by applying to the fm record input, a modulating signal that is 1/3 the data bandwidth. Then minimize the third harmonic content in the fm reproduce data signal output by adjusting the $2f_o$ control (on the headdriver card). Proceed as follows:

1. Apply the standard ac input. Set the frequency of the oscillator to the one listed in Table 8B-7 for the highest tape speed available.

2. Place the transport in the forward-record mode, at the highest tape speed available.

3. Set the distortion analyzer to measure the third harmonic of the test frequency.

4. Adjust the appropriate $2f_o$ control for minimum third harmonic distortion.

5. Repeat steps i through u for the other fm demodulators. Proceed to signal-to-noise test in Section 7B page 7B-2 of this manual.

FM DEMODULATOR ADJUSTMENT USING CALIBRATED FM MODULATOR

Adjust the demodulator as follows:

a. Connect test equipment as indicated in Figure 8B-3 with the oscilloscope and digital voltmeter connected to the fm demodulator output (across a 75 ohm load).

b. Patch test point TP2 of calibrated fm modulator to test point TW7 of an fm demodulator. Short the input of the calibrated fm modulator to ground.

c. Place the RECORD TEST switch S7 (on the power and servo chassis) in the ON position.

Table 8B-6. FM Wideband II Equalizer Test Frequencies

TAPE SPEED (ips)	TEST FREQUENCY (kHz)	EQUALIZER POTENTIOMETER
120	200	R31
60	100	R33
30	50	R35
15	25	R37
7-1/2	12.5	R39
3-3/4	6.25	R41
1-7/8	3.125	R43

Table 8B-7. Second Harmonic Adjustment Test Frequencies

TAPE SPEED (ips)	TEST FREQUENCY (kHz)
120	166.6
60	83.3
30	41.6
15	20.8
7-1/2	10.4
3-3/4	5.2
1-7/8	2.6

d. Adjust the zero adjustment potentiometer R91 on the fm demodulator, for a zero voltage reading on the digital voltmeter.

e. Remove the short to ground from the fm modulator input and apply the positive standard dc input (+1.414V).

f. Adjust reproduce output level potentiometer R102, for +1.414V dc (on the digital voltmeter).

g. Apply the negative standard dc input (-1.414V) at the fm modulator input. Verify that the negative dc output level (-1.414V), is within limits shown on the specification sheet. If not, readjust R102 slightly and, with the positive standard input applied, repeat steps f through g.

h. Repeat steps a through g for all the other fm demodulators.

i. Return the record test switch S7 to the OFF position.

j. Proceed to step k to optimize each fm demodulator in turn for the best signal-to-noise ratio, and minimum second and third harmonic distortion.

k. Place the transport in the forward record mode at the lowest tape speed available.

l. Adjust fm modulator carrier level control R110 for minimum noise reading on the electronic ac voltmeter (at the fm demodulator output).

m. Adjust R2 (WII band) head-normalizing potentiometer, on the equalizer board for a minimum noise reading on the ac vtvm.

NOTE

Steps l and m optimizes the WII fm system for best signal-to-noise ratio.

n. Remove the ground from the fm modulator input and apply the standard ac input. Set the frequency of the sine-wave oscillator to the one listed in Table 8B-6 for the highest tape speed available. Connect the wave analyzer to the fm demodulator output.

o. Place the transport in the forward record mode at the highest tape speed available.

p. Set the distortion analyzer to measure the second harmonic of the test frequency fundamental.

q. Adjust the appropriate equalizer potentiometer (see Table 8B-6) for minimum second harmonic distortion.

r. Minimize the second harmonic distortion with the appropriate equalizer potentiometers at the remaining available tape speeds.

s. Press the transport STOP pushbutton.

t. If the record head second harmonic adjustment ($2f_o$) has already been made for a Direct Record/Reproduce System leave it as set for the FM System also. If the $2f_o$ adjustment has not been previously set proceed to step u.

u. Make the record head second harmonic ($2f_o$) adjustment by applying to the fm record input, a modulating signal that is 1/3 the data bandwidth (see Table 8B-7). Then minimize the third harmonic content in the fm reproduce data signal output by adjusting the $2f_o$ control (at the front of the transport). Proceed as follows:

1. Apply the standard ac input. Set the frequency of the oscillator to the one listed in Table 8B-7 for the highest tape speed available.

2. Place the transport in the forward-record mode, at the highest tape speed available.

3. Set the distortion analyzer to measure the third harmonic of the test frequency fundamental.

4. Adjust the appropriate $2f_o$ control for minimum third harmonic distortion.

5. Repeat steps k through u for the other fm demodulators. Proceed to the signal-to-noise test in Section 7B page 7B-2 of this manual.

FM DEMODULATOR SQUELCH ADJUSTMENT

Perform the fm demodulator squelch adjustment as follows:

a. Connect test equipment as indicated in Figure 8B-3 with the oscilloscope and ac vtvm connected to the fm demodulator output (TP5), across a 75 ohm load.

b. Turn on the system power.

c. Set potentiometer R25 (on the countdown printed wiring board P3) fully ccw.

d. Operate the tape transport at the lowest tape speed for which there are low pass filter plug-ins in the reproduce mode. Ensure that the capstan servo is in sync (SYNC indicator illuminated).

e. Note that noise level measured by the ac vtvm and the oscilloscope.

f. Slowly adjust R25 in a clockwise direction until there is no significant decrease in noise level. The negative noise spikes are of mininum amplitude at this setting.

g. Turn off the system power.

h. Repeat steps a through g for the remaining channels.

i. Turn off system power. Disconnect test equipment.

GENERAL

Interchangeable modular printed circuit cards are used throughout the FM Signal Electronics system. Interchange of these modules should not be made after system alignment unless the channels affected by the interchange are realigned.

Before proceeding with the alignment, ensure that:

a. The heads are degaussed.

b. Fully degaussed tape is loaded for forward operation.

c. The electronic modules are correctly set for the desired bandwidth.

d. The fm modulator is correctly jumpered for input sensitivity and impedance (refer to Tables 8B-8 and 8B-9).

e. The fm demodulator is correctly jumpered (refer to Tables 8B-10 and 8B-11.

f. If the fm calibrator is to be used, follow the procedures as instructed in the calibrator manual, Ampex 1801933, and make certain that the RECORD TEST switch S7 on the inner test panel is in the OFF position. DO NOT initiate the reproduce mode when calibrating the demodulators.

The fm system must be configured for one of the following bandwidths:

a. Lowband - dc to 20 kHz (120 ips).

b. Intermediate band - dc to 40 kHz (120 ips).

c. Wideband group I - dc to 80 kHz (120 ips).

The calibration procedure for the fm record/reproduce electronics is similar for lowband (L), intermediate band (I), and wideband group I (W) system configurations. Tables included in this section list setup frequencies to cover these bandwidths. One general alignment procedure will be used for W, I, and L system calibration. The correct setup frequencies must be utilized for the bandwidth being aligned. Minor variations in calibration will be covered in the text of the alignment procedure.

Adjustment controls for the fm record/reproduce signal electronics system are shown on the inside of the electronics tray front cover door (See Figure 8B-4). The second harmonic ($2f_o$) and BIAS controls are located on the head-driver card. They are accessible from the front of the transport, beneath the head cover plate.

DEFINITIONS

STANDARD INPUT SIGNAL

A standard input signal is applied to the fm record amplifier for test purposes. It is defined as: that input signal level which deviates the fm modulator from its center carrier frequency (ccf) ±40% for W,I, L bipolar operation. If the fm modulation is configured for unipolar operation the fm carrier frequency will be deviated positive or negative 80% for W,I, L operation.

The fm calibration procedure given in this chapter will use the following input voltage levels for test purposes.

a. A standard dc input at positive or negative 1.414V.

b. A standard ac input at 1V rms.

The fm modulator may be calibrated for other input signal levels if desired. Fm record input attenuator jumpering must be configured to accept the maximum peak voltage at its input.

STANDARD OUTPUT LEVEL

The reproduce output level control is normally adjusted to produce an output signal amplitude of 1V rms as measured across the proper terminating impedance, when reproducing a STANDARD INPUT SIGNAL LEVEL. This signal is known as the STANDARD OUTPUT LEVEL. (Values other than 1 volt rms may be used, but degradation in signal-to-noise or distortion may result.)

HIGHEST TAPE SPEED AVAILABLE

Defined as: the highest tape speed for which data filters are available. It will be referred to as "the highest tape speed available" in the alignment procedures.

LOWEST TAPE SPEED AVAILABLE

Defined as: the lowest tape speed for which data filters are available. It will be referred to as "the lowest tape speed available" in the alignment procedures.

FM MODULATOR ALIGNMENT

There are two methods of aligning an fm modulator

a. Using standard test equipment.

b. Using a calibrated fm demodulator.

FM MODULATOR ALIGNMENT USING STANDARD TEST EQUIPMENT

To align the fm modulator, using standard test equipment, proceed as follows:

NOTE

Allow 15 minutes warmup before making final adjustments.

a. Connect test equipment as shown in Figure 8B-5.

b. Connect the electronic counter and the oscilloscope to the fm modulator output (TP2).

c. Ground the fm modulator input.

d. Turn system and transport power on. Set the transport speed selector to the highest tape speed available (do not move tape).

e. Adjust carrier level control R110, for 2V p-p at TP2. (This is a preliminary adjustment).

f. Adjust center carrier frequency control R29, for center carrier frequency (±0.1%). See Table 8B-12.

g. Remove the ground from the fm modulator input and apply a positive standard dc input (+1.414V).

h. Adjust deviation level control R32 for maximum positive deviation frequency (+40% for WIL, refer to Table 8B-12).

i. Apply the negative standard dc input (-1.414V) and measure maximum negative deviation frequency (-40% for WIL, refer to Table 8B-12).

j. Optimize linearity, (full band deviation tolerance ±0.5%, refer to Table 8B-12), by adjusting R32 slightly if necessary.

k. Repeat steps a through j for all other cards to be aligned.

l. Turn system power off. Remove the test equipment from the fm modulator.

m. This completes alignment of the carrier frequencies of the fm modulator, for all speeds. Proceed to bias level adjustments.

FM MODULATOR ALIGNMENT USING CALIBRATED FM DEMODULATOR

To align the fm modulator using a calibrated fm demodulator, proceed as follows:

a. Patch test point TP2 of the fm modulator to test point TP7 of the calibrated fm demodulator.

b. Connect the equipment as shown in Figure 8B-5.

c. Short the input of the fm modulator to ground. Turn system and transport power on.

d. Place the RECORD TEST switch S7 in the ON position (S7 is located on the power and servo unit).

e. Adjust the center carrier frequency control R29 on the fm modulator for a zero reading on the digital voltmeter at the fm demodulator output.

f. Remove the short and apply a positive standard dc input of +1.414V to the input of the fm modulator.

g. Adjust the deviation level control R32 on the fm modulator for a reading of +1.414V dc at the output of the fm demodulator.

h. Apply a negative standard dc input of -1.414V to the input of the fm modulator and optimize the deviation level control R32 for the best linearity between step g and h.

i. Repeat steps a through h for the other fm modulators using the same calibrated fm demodulator. Proceed to the bias level adjustment

Table 8B-8. Modulator Jumper Positions for Narrowband (W, I, L)

CIRCUIT INVOLVED	ACTION	JUMPER	REMARKS
Low-pass filter L2-L4, C37-C42 (Two jumpers for bandwidth group, one IN, one OUT)	Insert	IN to W,I,L	Connects carrier input to low-pass filter
	Insert	OUT to W,I,L	Connects low-pass filter to R110 (DRIVE ADJ)
NORMAL/DUB output (factory set to normal)	Insert	NORMAL	Connects carrier to output amplifier
Frequency divider output (wideband group I operation)	Insert	IN to W	Selects 432 kHz center carrier for wideband (W) operation (0-80 kHz data band at 120 ips)
Frequency divider output (intermediate operation)	Insert	IN to I	Selects 216 kHz center carrier for intermediate (I) operation (0-40 kHz data band at 120 ips)
Frequency divider output (low operation)	Insert	IN to L	Selects 108 kHz center carrier for lowband (L) operation (0-20 kHz data band at 120 ips)
Controlled multivibrator (factory set to normal)	Insert	NORMAL	Enables controlled multivibrator circuit
Center carrier offset (normally set to center at factory)	Insert	CENTER	Configures basic fm modulator for bipolar operation
Center carrier frequency adjustment	Set	R29 (CCF ADJ) adjusted for: 432 kHz (W), 216 kHz (I), or 108 kHz (L) at TP2 (yellow) with no data input. (This procedure is carried out during alignment of the fm system electronics-see table 8B-12.	Calibrates basic modulator for (W,I,L) operation

Table 8B-8. Modulator Jumper Positions for Narrowband (W,I,L) (Continued)

CIRCUIT INVOLVED	ACTION	JUMPER	REMARKS
Center carrier offset* (0V to -1V peak minimum)	Insert	W,I,L to HI	Offsets carrier frequency +40%, for 0 to negative unipolar data input
Center carrier offset* (0V to +1V peak minimum)	Insert	W,I,L to LO	Offsets carrier frequency -40%, for 0 to positive unipolar data input

*NOTE

If unipolar operation is required (provided on special order only) the following center carrier offset jumper must be in place. See Figure 8B-6.

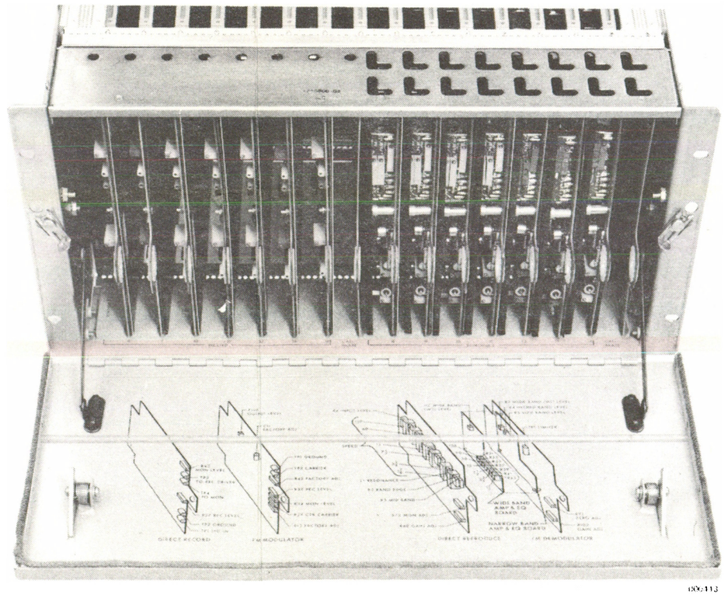


Figure 8B-4. Signal Electronics Tray - Showing Signal Electronics Adjustment Callouts

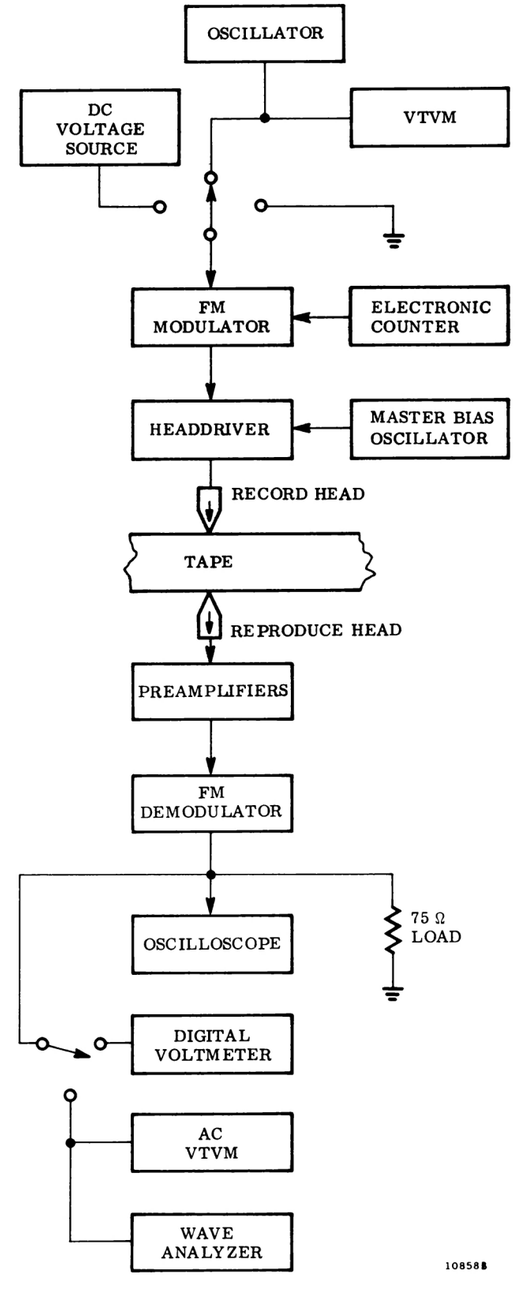


Figure 8B-5. FM Signal Electronics Test Setup

Table 8B-9. Data Input Voltage Range and Impedance Selection for Wideband I, Intermediate and Low Bands (WIL) Operation

INPUT IMPEDANCE	INPUT VOLTAGE	ACTION	JUMPER	REMARKS
20 kΩ	0.5V to 2.5V peak	Insert Insert Remove	W,I,L-20K JPR-1 Remaining jumpers	Selects 20 kΩ impedance Attenuation 1:1 Disconnects unused attenuators
20 kΩ	1.6V to 7.9V peak	Insert Insert Remove	W,I,L-20K JPR-2 Remaining jumpers	Selects 20 kΩ impedance Attenuation $\sqrt{10:1}$ Disconnects unused attenuators
20 kΩ	5.0V to 25V peak	Insert Insert Remove	W,I,L-20K JPR-3 Remaining jumpers	Selects 20 kΩ impedance Attenuation 10:1 Disconnects unused attenuators
1 kΩ	0.5V to 2.0V peak	Insert Insert Remove	W2-1K JPR-4 Remaining jumpers	Selects 1 kΩ impedance Attenuation 1:1 Disconnects unused attenuators
1 kΩ	1.6V to 7.9V peak	Insert Insert Remove	W2-1K JPR-5 Remaining jumpers	Selects 1 kΩ impedance Attenuation $\sqrt{10:1}$ Disconnect unused attenuators
1 kΩ	5.0V to 25V peak	Insert Insert Remove	W2-1K JPR-6 Remaining jumpers	Selects 1 kΩ impedance Attenuation 10:1 Disconnects unused attenuators
75Ω	0.5V to 2.5V peak	Insert Insert Insert Remove	W2-1K 75Ω JPR-4 Remaining jumpers	Selects 1 kΩ impedance Reduces Z to 75Ω Attenuation 1:1 Disconnects unused attenuators

Table 8B-9. Data Input Voltage Range and Impedance Selection for Wideband I, Intermediate and Low Bands (WIL) Operation (Continued)

INPUT IMPEDANCE	INPUT VOLTAGE	ACTION	JUMPER	REMARKS
75Ω	1.6V to 7.9V peak	Insert Insert Insert Remove	W2-1K 75Ω JPR-5 Remaining jumpers	Selects 1 kΩ impedance Reduces Z to 75Ω Attenuation $\sqrt{10:1}$ Disconnects unused attenuators
75Ω	5.0V to 10V peak	Insert Insert Insert Remove	W2-1K 75Ω JPR-6 Remaining jumpers	Selects 1 kΩ impedance Reduces Z to 75Ω Attenuation 10:1 Disconnects unused attenuators

CAUTION

DO NOT EXCEED 10V PEAK (7V RMS) SIGNAL INPUT WHEN USING AN INPUT IMPEDANCE OF 75 OHMS. DAMAGE TO THE 75 OHM IMPEDANCE MATCHING RESISTORS (R1, R2) WILL RESULT.

Table 8B-10. Demodulator Jumper Positions for Wideband I,* Intermediate and Low Band (WIL) for Mother Board

CIRCUIT INVOLVED	ACTION	JUMPER	REMARKS
Countdown multivibrator	Insert	WIL	Frequency adjustment of multivibrator
Dc offset	Insert	WIL	Dc zero balance resistance set for WIL

*See Figure 8B-7.

BIAS LEVEL ADJUSTMENT

Adjust the bias level as follows:

a. Turn system power off. Connect the equipment as shown in Figure 8B-5.

b. Set the head normalizing potentiometer(s) on the fm demodulator equalizer module to mid scale. These potentiometers are numbered as follows, for bandwidths indicated.

1. R3-W 2. R4-I 3. R5-L

c. Connect a positive standard dc input of +1.414V to the input of the modulator.

d. Connect the oscilloscope to the fm demodulator equalizer output, at TP1. Use a low capacitance (10:1) oscilloscope test probe. Turn system power on.

e. Place the transport in the forward record mode at the highest tape speed to be checked.

f. Observe the output of the fm demodulator at TP1 on the oscilloscope. Adjust the ac BIAS potentiometer (on the headdriver) for maximum output at test point TP1. If clipping or distortion occurs, lower the modulator drive (R110) until clipping is eliminated, readjust the bias potentiometer.

g. Apply a standard ac input signal - 1V rms of 0.1 of the maximum modulation frequency (see Table 8B-12).

h. Readjust the head normalizing potentiometer R3-W, R4-I, or R5-L for a maximum signal at TP1 short of clipping and distortion; but not in excess of 1V p-p.

i. Repeat steps a through h for each channel of electronics.

j. Press the transport STOP pushbutton. Disconnect the oscilloscope from the last fm demodulator used.

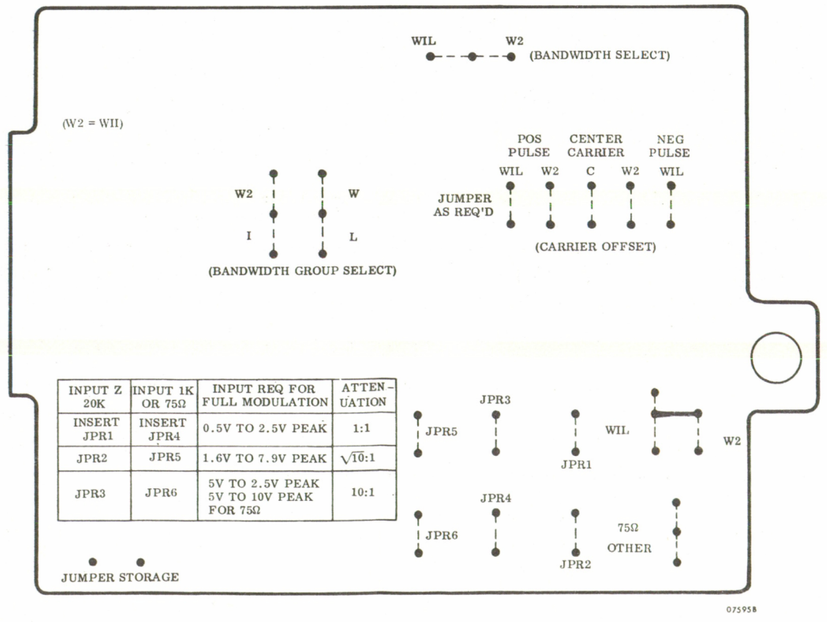


Figure 8B-6. FM Modulator - Location of Jumper Positions

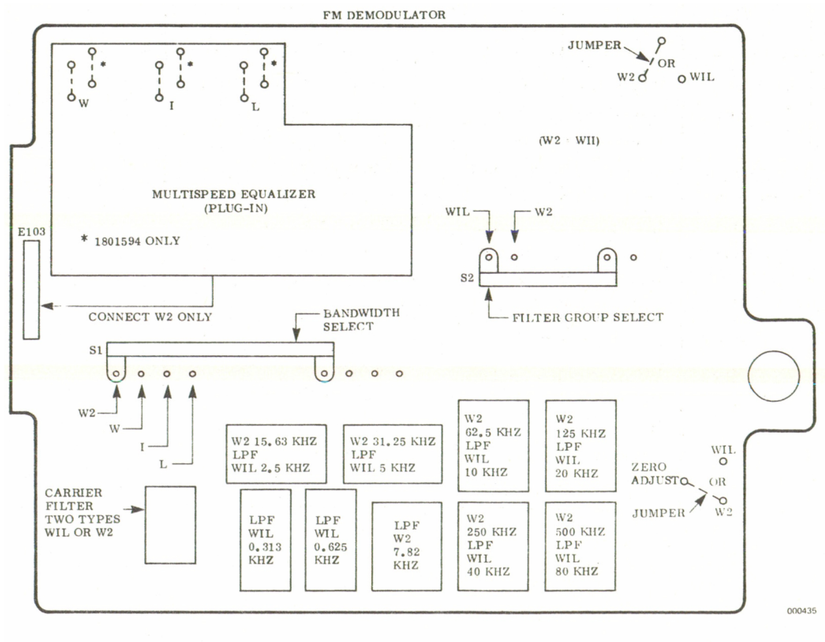


Figure 8B-7. FM Demodulator - Configuration of Bandwidth Components

Table 8B-11. Fm Demodulator Subassemblies: Plug-ins and Jumper Positions*

CIRCUIT INVOLVED	ACTION	PLUG-IN OR JUMPER	REMARKS
Low-pass filter assemblies 1801601-01 through -09	Plug-in speed positions	- - -	Provides filtering for individual speeds
WIL Band input amplifier and equalizer assembly 1801594	Plug-in	- - -	Connect E103 to the edge pin connectors carrying the speed switching lines
Carrier filter assembly 1801602	Plug-in	- - -	Provides carrier rejection for WIL bandwidths
Filter group select plug P2 (S2)	Position in WIL	S2	Selects filter for WIL
Bandwidth select plug P1 (S1)	Position in W	S1	Selects bandwidth components for W band on the equalizer board connect both W jumpers (I and L jumpers must not be used)
Bandwidth select plug P1 (S1)	Position in I	S1	Selects bandwidth components for I band on the equalizer board connect both I jumpers (W and L jumpers must not be used)
Bandwidth select plug P1 (S1)	Position in L	S1	Selects bandwidth components for L band. On the equalizer board connect both L jumpers. (W and I jumpers must not be used)

*See Figure 8B-7

Table 8B-12. Wideband Group I, Intermediate and Low Band (WIL) Frequencies

TAPE SPEED (ips)			CENTER CARRIER	CENTER CARRIER TOLERANCE (±0.1%)	MAX + DEVIATION (+40%)	MAX - DEVIATION (-40%)	FULL BAND DEVIATION	FULL BAND TOLERANCE (±0.5%)	MODULATION FREQUENCY BANDWIDTH		
W	I	L							W	I	L
120	. . .	. . .	432 kHz	±432 Hz	604.8 kHz	259.2 kHz	345.6 kHz	±1.7 kHz	DC-80 kHz	. . .	. . .
60	120	. . .	216 kHz	±216 Hz	302.4 kHz	129.6 kHz	172.8 kHz	±864 Hz	Dc-40 kHz	Dc-40 kHz	. . .
30	60	120	108 kHz	±108 Hz	151.2 kHz	64.8 kHz	86.4 kHz	±432 Hz	Dc-20 kHz	Dc-20 kHz	Dc-20 kHz
15	30	60	54 kHz	±54 Hz	75.6 kHz	32.4 kHz	43.2 kHz	±216 Hz	Dc-10 kHz	Dc-10 kHz	Dc-10 kHz
7-1/2	15	30	27 kHz	±27 Hz	37.8 kHz	16.2 kHz	21.6 kHz	±108 Hz	Dc-5 kHz	Dc-5 kHz	Dc-5 kHz
3-3/4	7-1/2	15	13.5 kHz	±13 Hz	18.9 kHz	8.1 kHz	10.8 kHz	±54 Hz	Dc-2.5 kHz	Dc-2.5 kHz	Dc-2.5 kHz
1-7/8	3-3/4	7-1/2	6.75 kHz	±7 Hz	9.45 kHz	4.05 kHz	5.4 kHz	±2.7 Hz	Dc-1.25 kHz	Dc-1.25 kHz	Dc-1.25 kHz
. . .	1-7/8	3-3/4	3.375 kHz	±3 Hz	4.725 kHz	2.025 kHz	2.7 kHz	±13.5 Hz	. . .	Dc-625 Hz	Dc-625 Hz
. . .	. . .	1-7/8	1.6875 kHz	±2 Hz	2.363 kHz	1.013 kHz	1.35 kHz	±6.75 Hz	. . .	. . .	Dc-312 Hz

FM DEMODULATOR ALIGNMENTS

There are two methods of aligning an fm demodulator:

a. Using standard test equipment.

b. Using a calibrated fm modulator (recommended method).

FM DEMODULATOR ADJUSTMENT USING STANDARD TEST EQUIPMENT

Adjust the demodulator as follows:

NOTE

Allow 15 minutes warmup before making final adjustments.

a. Connect test equipment as indicated in Figure 8B-5 with the oscilloscope and digital voltmeter connected to the fm demodulator output (across a 75 ohm load). Short the input to the fm modulator to ground.

b. Place a jumper between test point TP2 of the fm modulator and TP7 of the fm demodulator. Turn on the system and transport power.

c. Throw the RECORD TEST switch S7 (on the power and servo unit) to the ON position.

d. Adjust zero adjustment potentiometer R91, on the fm demodulator, for a zero voltage reading on the digital voltmeter.

e. Remove the ground from the fm modulator input and apply the positive standard dc input (+1.414V).

f. Adjust reproduce output level potentiometer R102, for +1.414V dc (on the digital voltmeter).

g Apply the negative standard dc input (-1.414V) at the fm modulator input. Verify that the negative dc output level (-1.414V), is within limits shown on the specification sheet. If not, readjust R102 slightly and, with the positive standard input applied, repeat steps f through g.

h. Return the RECORD TEST switch S7 to the OFF position.

i. Disconnect the standard dc input voltage from the modulator and substitute a short circuit to ground at the record input.

j. Disconnect the digital voltmeter and connect an electronic ac voltmeter to the fm reproduce output (across the 75Ω load).

k. Adjust the second harmonic adjust ($2f_o$) on the headdriver card to its mid position and leave it there (single turn potentiometer).

l. Place the transport in the forward record mode at the lowest tape speed available.

m. Adjust fm modulator carrier level control R110 for minimum noise reading on the electronic ac voltmeter (at the fm demodulator output).

n. Adjust R3 (W band), R4 (I band), or R5 (L band) head-normalizing potentiometer, on the equalizer board, for a minimum noise reading on the ac vtvm.

NOTE

Steps l and n optimize the W, I, L, fm systems for best signal-to-noise ratio.

o. Repeat steps i through n for the other fm demodulators. Proceed to the signal-to-noise test in Section 7B page 7B-3 of this manual.

FM DEMODULATOR ADJUSTMENT USING CALIBRATED FM MODULATOR

Adjust the demodulator as follows:

a. Connect test equipment as indicated in Figure 8B-5 with the oscilloscope and digital voltmeter connected to the fm demodulator output (across a 75 ohm load).

b. Patch test point TP2 of calibrated fm modulator to test point TP7 of an fm demodulator. Short the input of the calibrated fm modulator to ground.

c. Place the RECORD TEST switch S7 (on the power and servo unit) in the ON position.

d. Adjust the zero adjustment potentiometer R91 on the fm demodulator, for a zero voltage reading on the digital voltmeter.

e. Remove the short to ground from the fm modulator and apply a 1V rms signal at 0.1 of the modulation frequency (see Table 8B-12) to its input. Substitute an ac vtvm for the digital voltmeter on the output of the fm demodulator.

f. Set the fm demodulator output level potentiometer R102 for a 1V rms reading on the ac vtvm.

g. Repeat steps a through f for all the other fm demodulators.

h. Return the RECORD TEST switch S7 to the OFF position.

i. Adjust the second harmonic adjust ($2f_o$) on the headdriver card to its mid position and leave it there (single turn potentiometer).

j. To optimize each fm demodulator in turn for the best signal-to-noise ratio, place the transport in the forward record mode at the lowest tape speed available.

k. Adjust fm modulator carrier level control R110 for minimum noise reading on the electronic ac voltmeter (at the fm demodulator output).

l. Adjust R3 (W band), R4 (I band), or R5 (L band) head-normalizing potentiometer, on the equalizer board for minimum noise reading on the ac vtvm.

m. Repeat steps i through l for the other fm demodulators. Proceed to the signal-to-noise test in Section 7B page 7B-3 of this manual.

FM DEMODULATOR SQUELCH ADJUSTMENT

Perform the fm demodulator squelch adjustment as follows:

a. Connect test equipment as indicated in Figure 8B-5 with the oscilloscope and ac vtvm connected to the fm demodulator output (TP5), across a 75 ohm load.

b. Turn on the system power.

c. Set potentiometer R25 (on the countdown printed wiring board P3) fully ccw.

d. Operate the tape transport at the lowest tape speed for which there are low pass filter plug-ins in the reproduce mode. Ensure that the capstan servo is in sync (SYNC indicator illuminated).

e. Note that noise level measured by the ac vtvm and the oscilloscope.

f. Slowly adjust R25 in a clockwise direction until there is no significant decrease in noise level. The negative noise spikes are of minim amplitude at this setting.

g. Turn off the system power.

h. Repeat steps a through g for the remaining channels.

i. Turn off system power. Disconnect test equipment.

SECTION 9
TROUBLESHOOTING

SECTION 9

TROUBLESHOOTING

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TROUBLESHOOTING

GENERAL

This section of the manual contains troubleshooting information pertinent to the signal electronic system and its operation. Those troubles which originate with the tape transport are covered in Section 10 of the FR3000 Transport Maintenance manual 1802854.

The purpose of troubleshooting is to locate and readjust, repair or replace malfunctioning components in order to place the recording/reproducing system in a fully serviceable condition as rapidly as possible. The troubleshooting procedures in this section are given in terms of location, blown fuses, malfunctioning printed wiring assemblies (pwa's), incorrectly connected cables, etc.

When a pwa is believed to be malfunctioning, applicable adjustment procedures should be performed first to eliminate the possibility of false trouble symptoms due to aging of components or accidental misadjustment. A good policy to follow when troubleshooting signal electronics pwa's is to exchange them with like pwa's prior to readjustment. If satisfactory operation is achieved in the new position, the module connector or the signal input connections should be checked. It is always a good practice to consider the possibility of maladjustment rather than malfunction.

Troubleshooting of individual modules, cables, connections, etc., should be done by standard signal tracing and circuit tracing methods. Reference the circuit descriptions, block diagrams, and schematic diagrams, etc., in the descriptive sections of the associated signal electronics manual when troubleshooting, i.e., FR3010 signal electronics manual Ampex 1802855.

Whenever a signal electronics pwa is believed to be malfunctioning, before assuming it is defective, complete the performance checks as per section 7 of this manual. This eliminates the possibility of badly recorded signals, improperly connected cables, and incorrectly positioned modules from being the actual causes of the suspected malfunction.

SPECIAL HANDLING OF MOS/CMOS DEVICES

All MOS/CMOS devices are susceptible to damage by the presence of a electrostatic field in the gate oxide region of the device. Although these devices have input protection networks, which are effective in a large number of device handling situations, they are not effective in 100% of the cases. The procedures below are intended to provide direction to the persons handling these devices.

MOS and CMOS integrated circuits may be identified by their vendor part numbers using table 9-1 below or by referring to the Ampex commercial parts catalog if available. Most MOS field effect transistors (MOSFETS) have JEDEC 3N or 4N registration. Non-registered house devices should be checked against commercial parts catalogs to determine whether or not they are MOS devices.

Personnel handling MOS or CMOS devices should wear antistatic smocks and gloves (cotton recommended). When handling individual devices, personnel should be grounded using conductive wrist straps. In no case should an operator be attached directly to a hard ground. There should always be at least a one (1) megohm series resistor between the operator and ground.

All work stations should have conductive material work surfaces and conductive floor mats attached to a common ground system. Chairs and stools should be made of metal or covered with antistatic material to prevent static charge generation.

Dropping of MOS and CMOS devices should be avoided due to possible contact with charged surfaces or objects.

When printed wiring boards containing mounted MOS devices are removed from equipment for test, shipping, storage, etc., "dummy" connectors should be used to electrically short all printed wiring board terminals together. A suitable alternative would be to contain the board in antistatic material. These precautions should be taken until the subassembly is inserted into the complete system in which the proper voltages are applied.

Table 9-1. MOS/CMOS Devices Presently Being Used in Ampex Equipment or Contained in Ampex Commercial Parts Catalog

VENDOR	SERIES
Electronic Arrays	EA1500
Fairchild	3100, 3200, 3300, 3500, 3700, 3800, 34000, 34500, 34700
Harris	74C
Intel	1100, 1700
Motorola	MC14000
National	54C/74C, MM5000, AH00, 4600/5600
Signetics	2500
Siliconix	DG
Solid State Scientific	SCL4000
RCA	CD4000, CD4300, CD4500
Solitron	CM4000
Western Digital	AR1400

GUIDES TO TROUBLESHOOTING SIGNAL ELECTRONICS

The tables or procedures which follow will provide general guides for troubleshooting. They are not complete nor comprehensive but should suggest approaches to locating faults not specifically covered. In any case of trouble where it is applicable, checking of cables and other interconnections should be carefully carried out even though they are not specifically mentioned in the table or procedure. Notice should be paid to the various indicators such as power on, signal levels, malfunction, etc. These provide circuit operation confidence or an indication of failure.

FUSE REPLACEMENT

Table 9-2 lists the circuit breaker and fuses of the FR3010 series transport primary power and signal electronics trays or housing power sources. For fuses that affect the FR3010 transport refer to table 10-2 in the troubleshooting section of the FR3000 Transport Maintenance Manual, Ampex 1802854.

Table 9-2. FR3010 Circuit Breaker and Fuses*

Location	Reference	Amps	Speed	Circuit
Power chassis panel	CB501	25	--	Two-pole main-power circuit breaker. All loads within the transport, plus utility outlets.
Power chassis panel	F501	10	Fast Blow	Ac outlets panel. Supplies cabinet fan and head-driver housing.
Power chassis panel	F502	10	Fast Blow	Ac outlets front panel.
Signal electronics tray	F1	3	Fast Blow	+25V Signal Electronics power supply.
Signal electronics tray	F2	3	Fast Blow	-25V Signal Electronics power supply
Headdriver Housing	F1	2	Slow Blow	Primary power (115V ac) for Headdriver and Preamplifier Power Supplies
Headdriver Housing	F2	4	Fast Blow	Power Supply for Bias Oscillator and Selective Record Relays (+24, +18V).
Preamp #2 Housing	F1	0.25	Fast Blow	+12V power for Preamp No. 1's.

*All fuses are 1/4" x 1 1/4" tubular

CHECKING CONNECTIONS IN REPRODUCE HEAD AREA

Extreme care should be taken whenever dealing with the head or preamplifier area. Refer to Section 11, page 11-3, of the FR3000 Transport Maintenance manual 1802854 for removal and replacement detail. When installing preamplifier No. 1's for the first time, it is imperative that the very small and fragile pins of the preamplifier are correctly aligned with the connector. The most practical way to do this is to remove the head assembly and individually insert the preamplifier No. 1's into their respective slots. There is some slight movement of the connector during the insertion process to aid in alignment.

When placing the connector on the preamplifier No. 1 pwa's again extreme caution must be taken to make sure that the connector of the cable and the pins of the preamplifier No. 1 are in correct alignment.

CAUTION

THE PINS ON THE PREAMPLIFIER ASSEMBLY ARE EXTREMELY FINE AND CAN BE EASILY BENT. EXTREME CARE MUST BE TAKEN WHEN INSERTING THE PREAMPLIFIER INTO THE HARNESS OR HOUSING ASSEMBLY NOT TO BEND THE PINS. DO NOT FORCE THE CONNECTION.

Normally 2 preamplifiers are placed on the preamplifier harness assembly (8 pins into harness as shown in the side view of Figure 9-1). Then the preamplifiers are inserted into the preamplifier No. 1 housing guides and carefully slid along the guides and into the connectors within the preamplifier No. 1 housing. The 2 preamplifiers and the connector of the preamplifier harness assembly should be considered as a single unit. The whole unit may be pushed into the preamplifier housing by light pressure on both ends of the preamplifier harness assembly connector.

The preamplifier harness assembly has two branches, one for odd channels, and the other for even channels.

The odd channel branch has one interconnect board for a 7 channel system, two interconnect boards for a 14 channel system, and four interconnect boards for a 28 channel system. Each interconnect board contains two preamplifier No. 1 connectors (e.g., P1 and P2). Each preamplifier No. 1 pwa contains preamplifers for two channels. Two preamplifier No. 1 pwa's plug into the interconnect board. Thus as shown in Figure 9-1D, a single interconnect board contains preamplifiers for four channels. The correct orientation for each preamplifier No. 1 pwa is shown in Figure 9-1C.

This orientation is also pictured on the connector clamp. The preamplifier No. 1's are numbered from the baseplate outward (see Figure 9-1B). The preamplifier harness leads to P2/P1 are the shortest, while the leads to P4/P3 are slightly longer.

The even channel branch is a mirror image of the odd channel branch. Its connectors are identified P1, P2, P3, etc., from the head baseplate outward. The preamplifer No. 1's they contain are for channels 2 and 4, 6 and 8, 10 and 12, etc. Refer to Tables 9-1 and 9-2.

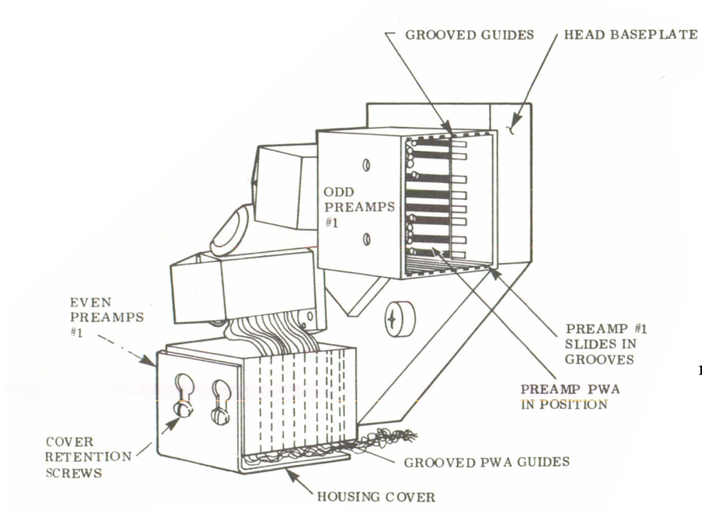

Figure 9-1A. Head ands Preamplifier #1 Housings

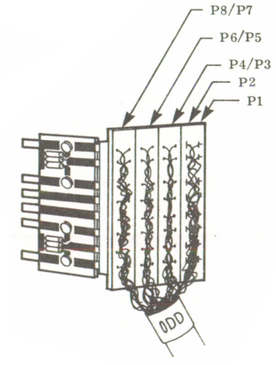

Figure 9-1B. Interconnect Boards and Harness Assembly with a Preamplifier #1 Pwa Installed

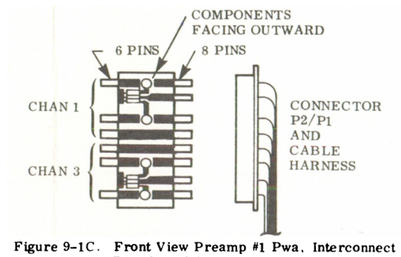

Figure 9-1C. Front View Preamp #1 Pwa, Interconnect Board, and Connectors

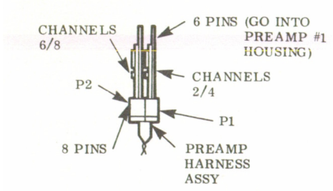

Figure 9-1D. Top View - Showing Two Preamp #1's Installed in Interconnect Board

000592

Figure 9-1. Preamplifier No. 1 Housing and Preamplifier No. 1 PWA Insertion Detail - 28 Channel Version Shown

Table 9-3. Preamplifier #1 and Connector Numbering for Odd Channels

CONNECTORS		P8	P7	P6	P5	P4	P3	P2	P1
		Numbered from Baseplate							
Number of Preamp #1 Pwa's Installed	7 Chans							1	1
	14 Chans					1	1	1	1
	28 Chans	1	1	1	1	1	1	1	1
Track Number	Top	27	23	19	15	13	9	5	1
	Bottom (In Connector)	-	25	21	17	-	11	7	3

Table 9-4. Preamplifier #1 and Connector Numbering for Even Channels

CONNECTORS		P8	P7	P6	P5	P4	P3	P2	P1
		Numbered from Baseplate							
Number of Preamp #1 Pwa's Installed	7 Chans							1	1
	14 Chans					1	1	1	1
	28 Chans	1	1	1	1	1	1	1	1
Track Number	Right	28	24	20	16	14	10	6	2
	Left (In Connector)	-	26	22	18	-	12	8	4

CHECKING HEADDRIVER CONNECTIONS

As may be seen in Figure 9-2, all of the cables that connect to the various headdriver pwa's are marked P1 (for 14 to 28 channels systems). For identification and ease of replacement, it is recommended that when these cables are disconnected they be tagged.

In 7 channel systems the cable has two plugs marked P1 and P2. Check to see if the location guide on Figure 9-2 is followed.

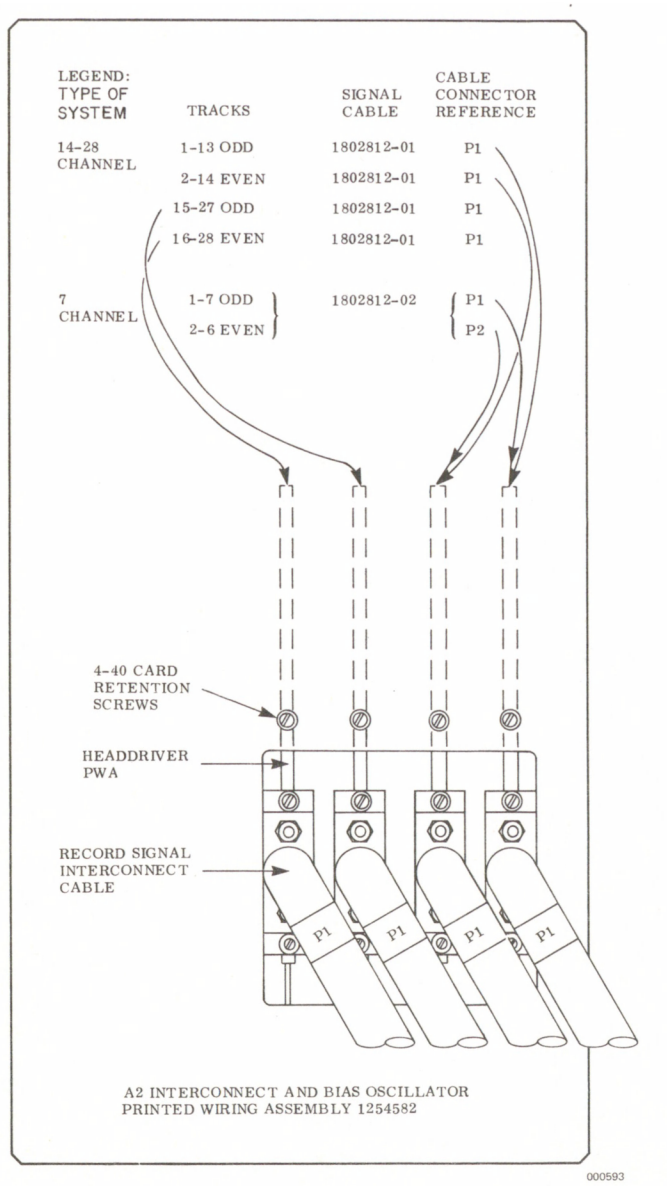

Figure 9-2. Headdriver Connector Detail

HIGH FREQUENCY/WIDEBAND SYSTEMS

These types of systems contain critical bias and head azimuth adjustments which, when incorrectly set, can cause a drop-off of the high frequency response of the system. When the performance checks (contained in Section 7) are done and high frequency response does not meet specifications, it is recommended that bias and head azimuth adjustments be performed as per Section 8 (excessively high bias and incorrect head azimuth will cause a reduction in high frequency signals).

If the performance checks indicate unacceptable amounts of system noise, this can probably be corrected if head degaussing and head cleaning is performed. However, a bad signal input connector, improperly seated pwa's, poor quality tape, could also be part of the problem. The procedures for cleaning and degaussing heads will be found in the Preventive Maintenance Section 6 of this manual.

In analog tape recorder/reproducer systems it is impractical to re-record over previously recorded data since the two data signals would mix; this results in meaningless reproduced data. Thus, incomplete degaussing of the tape could also cause an increase in system noise.

The inability to playback a previously recorded tape may stem from incorrect setting of equalization or improper programming of the record pwa's. The adjustment of the equalizers for the direct system is covered in Section 8 of this manual. Programming of the various speed elements, impedance matching circuits and input levels are covered in the Operating Procedures in Section 3. When signals are higher in amplitude than programmed for initially (i.e. system programmed for a .25 to 1V signal and actual signal is 7V), the amount of distortion will be unacceptable. The fault lies with the original recording not the reproducing system. The recorder amplifier should be programmed for a higher level of input signal.

TAPE MOTION TROUBLESHOOTING

When problems occur in the motion of the tape such as excessive flutter, skewing, incorrect tension, etc., the troubleshooting guides in the FR3000 Tape Transport Manual, Ampex 1802854, Section 10 should be referred to as an aid to troubleshooting the system.

SECTION 10
REMOVAL AND REPLACEMENT

SECTION 10

REMOVAL AND REPLACEMENT

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LIST OF ILLUSTRATIONS

GENERAL

This section gives the procedures for field removal and replacement of components located within trays, housings, etc., for which removal procedures are not self evident. Such items are power supplies, power supply regulators, headdriver pwa's, preamplifier No. 1 pwa's, preamplifier No. 2 pwa's and various connectors associated with these items.

The removal and replacement procedures for components which are part of the tape transport are contained in Section 11 of the FR3000 Transport Maintenance Manual, Ampex 1802854.

SIGNAL ELECTRONICS TRAY REMOVAL

Refer to Figures 10-1 and 10-2. Disconnect all power and signal cables from the rear of the signal electronics bay. Remove the signal electronics bay from the transport in the following manner:

a. Depress the two rectangular knobs located on the front of the front panel and lower the panel.

b. Release the two snap-slide fasteners, located one on each side of the tray frame, and move the signal electronics tray out to its farthest extent.

c. Lift the two slide rail catches, located one on each side within the mounting slides, and remove the tray from the guides.

d. Place signal electronics tray right side up on clean surface.

SIGNAL ELECTRONICS TRAY REPLACEMENT

To reinstall signal electronics bay, proceed as follows:

a. Place the tray slide rails into the guides and push the tray forward until it locks into position.

b. Lift the slide rail catches and push the tray into its normal position.

c. Fasten the two snap-slide fasteners to their securing posts.

d. Close the front panel.

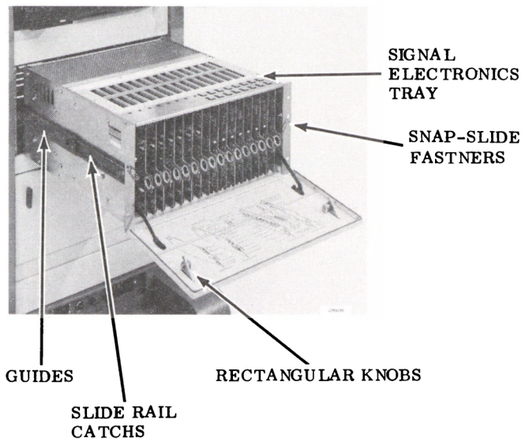

Figure 10-1. Signal Electronics Tray-Extended View

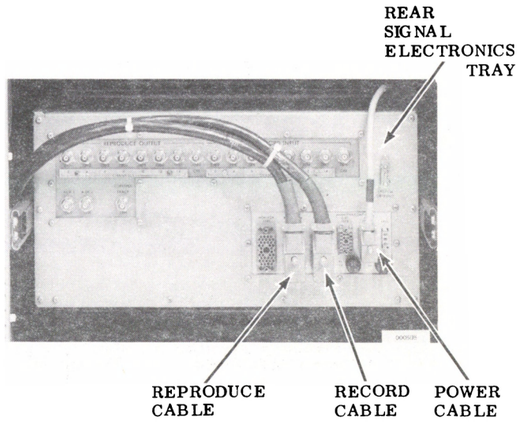

Figure 10-2. Signal Electronics Tray-Rear View

SIGNAL ELECTRONICS POWER SUPPLY REMOVAL

Refer to Figures 10-1, 10-2 and 10-3. To remove signal electronics power supplies from the signal electronics bay, proceed as follows:

a. Remove the top mesh cover from the power supply enclosure by removing four 6-32 cross recessed screws at the sides and lifting off.

b. Turn tray assembly upside down.

c. Remove bottom mesh cover from power supply enclosure by removing eight 6-32 cross recessed screws and lifting cover off.

d. Tag and disconnect the cables from the + and -25V power supplies.

e. Remove cable clamps.

f. Remove two 10-32 cross recessed screws securing the common ground strap and +25V power supply (inboard) to the power supply bracket. Care should be taken not to lose the fiber-washer that insulates each screw from the common ground strap.

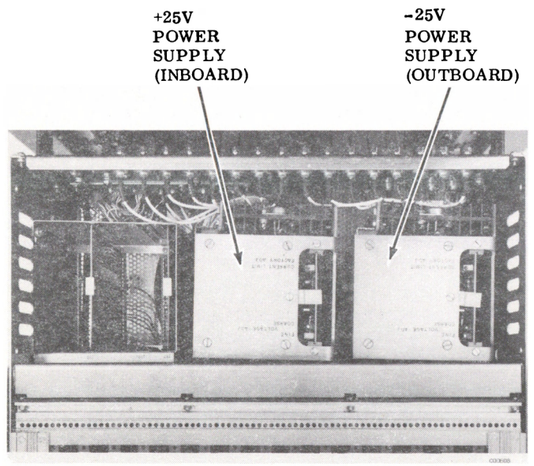

Figure 10-3. Signal Electronics Tray-Top Cover Off Showing Power Supply.

g. Remove the glass epoxy insulator (rectangular) from beneath the common ground strap.

h. Carefully lift the common ground strap out of the way and replace the two 10-32 screws and their insulators into the power supply bracket and power supply.

i. Turn the signal electronics tray assembly on its left side. (In this state the power supplies will be upward.)

j. Remove the two 10-32 cross recessed screws which hold the power supply bracket to the signal electronics tray.

k. Holding the power supply and bracket assembly, turn the signal electronics tray on its right side. (In this state the power supplies will be downward).

l. Holding the power supplies and power supply mounting bracket assembly, remove the two 10-32 cross recessed screws that are still holding the power supply mounting bracket to the signal electronics tray.

m. Carefully remove the power supplies and the mounting bracket from the tray assembly by pulling them through the top opening.

n. Four 10-32 screws hold each of the power supplies to the power supply mounting bracket. To remove a power supply from the power supply bracket, remove the four 10-32 screws. (It will be necessary to remove the outboard power supply to gain access to the inboard power supply mounting screws.)

SIGNAL ELECTRONICS POWER SUPPLY REPLACEMENT

Refer to Figure 10-3. To reinstall the power supplies in the signal electronics tray, proceed as follows:

a. The two power supplies should be mounted to their bracket and considered as a unit.

b. Turn the tray assembly on its right side.

c. Insert power supply unit carefully into the tray. Line up the 10-32 mounting holes in the tray assembly and the power supply unit.

d. Insert two 10-32 cross recessed screws and screw down part way.

e. Turn tray assembly onto left side being careful to support the power supply unit as the turn is being made.

f. Line up the power supply bracket holes with those in the tray assembly. Insert the 10-32 mounting screws and screw down part way.

g. Place the tray assembly on its top and complete tightening down of the four 10-32 holding screws of the power supply bracket.

h. Replace the cables in accordance with the tags (previously done when they were removed) to their respective power supplies. Make sure that the twisted pairs run beneath the RECORD-IN cable.

i. Replace cable clamps holding twisted pairs to -25V and +25V power supplies.

j. Remove two 10-32 screws holding the inboard power supply to the power supply bracket.

k. If there is a ground strap between the system ground and the adjacent ground terminal at the rear of the signal electronics tray, remove it.

l. Replace rectangular glass epoxy insulator between common ground strap (at the +25V power supply position) and the power supply bracket.

m. Replace the two screws. Care must be taken to assure that the screw does not touch the hole in the common strap. Check with an ohmmeter. There should be no continuity between the screw-head and the common ground strap or the common ground strap and the power supply mounting bracket.

n. If ground strap was removed at the rear of the signal electronics tray, replace it.

o. Replace the bottom mesh cover plate. (Eight 6-32 cross recessed screws required.)

p. Turn signal electronics tray right side up.

q. Replace top mesh cover plate. (Four 6-32 cross recessed screws required.)

REMOVAL AND REPLACEMENT OF HEADDRIVER PWA's

To remove a headdriver pwa, proceed as follows:

a. Tag and disconnect the head cables. Two 4-40 screws hold each of the head connectors to the front of the headdrivers.

b. Tag the record signal cables to the headdriver pwa's. (All of the cables in a 14 or 28 channel system are marked P1 as shown in Figure 10-4.)

c. Remove the two 4-40 connector retention screws from each of the record signal cable connectors.

d. Disconnect the record signal cables from the headdriver pwa's.

e. Remove the 4-40 card retention screw from each headdriver pwa. See Figure 10-4.

f. The headdriver pwa's may now be removed from the front of the headdriver housing.

g. Replace the headdriver pwa's and connect the cables in the reverse order given above.

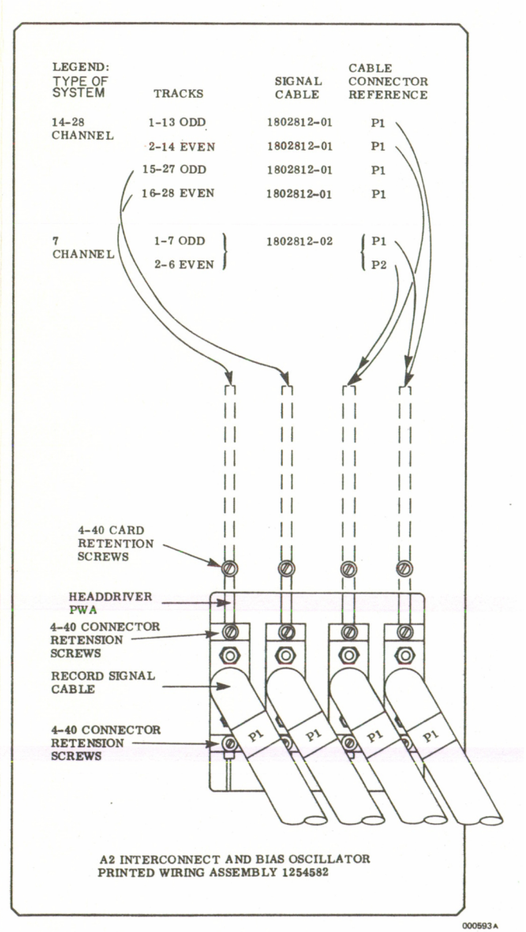

Figure 10-4. Headdriver Housing Mother PWA -Showing PWA and Cable Connector Securing Screws

HEADDRIVER HOUSING COMPONENTS REMOVAL AND REPLACEMENT

In order to remove or replace components within the headdriver housing such as the regulator board, transformers, filter capacitors, and regulating transistors, etc., it is necessary to remove the headdriver housing from the transport baseplate.

HEADDRIVER HOUSING - REMOVAL FROM TRANSPORT BASEPLATE AND DISASSEMBLY

Reference Figure 10-5. To remove the headdriver housing assembly from the transport baseplate, proceed as follows:

a. Disconnect cable P3 from the preamplifier No. 2 housing.

b. Disconnect cable P2 from J206.

c. Unplug the ac power cable from the ac outlet.

d. Remove the record signal cables and headdriver cards as per procedures under Removal and Replacement of Headdriver Pwa's.

e. Remove the cables and the cable clamps at the rear of the headdriver housing and the side of the transport cabinet (secures ac power cable).

f. Remove the two lower hex socket head screws which hold the headdriver housing to the transport baseplate. (Refer to Figure 10-5.)

g. Support the headdriver housing (it is heavy due to transformers and other components contained therein) and remove the two upper hex socket head screws.

h. Place the headdriver housing assembly on a clean surface face down (mother board upward).

i. Referring to Figure 10-5, remove the 13 6-32 screws along the perimeter shown, i.e., two to the right of the fan, three on the top edge of the mother board, five on the left side of the mother board (the two which hold the cable clamps have already been removed in step e - they are 0.5" in length whereas the balance of the screws being removed are 0.38" in length), and three on the bottom lefthand edge of the housing end plate.

j. Referring to Figure 10-5, remove the four 6-32 cross recessed screws that form a square at the top of the right side panel.

k. Grasp the mother board and right side panel (connected together) and remove them as a unit from the heatsink and transformer assembly (extremely heavy - will remain on bench top without assistance), by lifting up and then to the right. This disconnects the connector on the mother board from P1 on the A1 regulator pwa. Due to the dressing of the cables inside the unit and the close fit of the sheet metal parts, extreme care should be taken during this step. It may be necessary for one person to hold the heatsink and transformer assembly while the second person removes the mother board and attached housing.

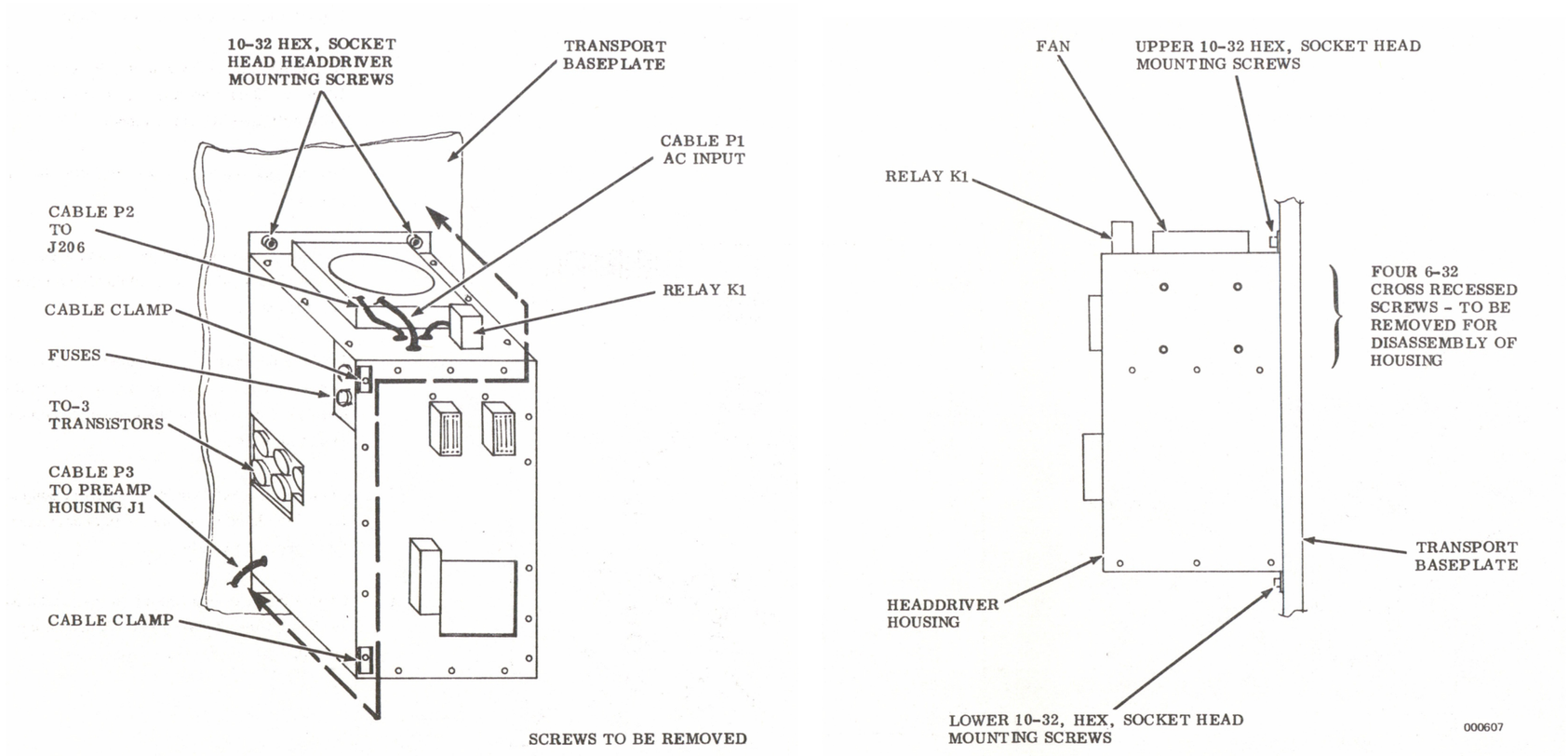

Figure 10-5. Headdriver Housing - Disassembly Details - Extender

The regulator pwa and transformer and capacitor assembly are now completely accessible for repair and replacement of components. See Figure 10-6.

REMOVAL AND REPLACEMENT OF THE REGULATOR PWA

To remove the regulator pwa (A1 regulator printed wiring assembly 1254584) it will be necessary to disconnect five large TO-3 transistors and their associated hardware from the heatsink. Care must be taken when removing leads from the transistors that their location be noted. If necessary, tag leads as they are removed.

REMOVAL OF THE REGULATOR PWA. To remove the regulator pwa, refer to Figure 10-7 and proceed as follows:

a. Disconnect the leads from the five TO-3 transistors.

b. Remove TO-3 transistor mounting hardware.

c. Remove transistors from heatsink and lay aside.

d. Remove the holddown screws from each of transistors Q4 and Q5.

e. Unsolder leads from E7 and E3 to CR1.

f. Remove 5 pwa holddown screws as indicated in Figure 10-7.

g. The pwa will now swing out and components are accessible for replacement or repair.

If the entire pwa must be replaced in addition to the removal of screws and unsoldering of leads given above, it will also be necessary to disconnect the wiring harness from the transformer and capacitor package. Care should be taken to tag the various leads with their associated solder point numbers (E35, etc.).

REPLACEMENT OF THE REGULATOR PWA. To replace the regulator pwa, refer to Figure 10-7 and proceed as follows:

a. Mount the regulator pwa to the heatsink assembly (five cross recessed screws).

b. Replace holddown screws in transistors Q4 and Q5.

c. Solder leads from E3 and E7 on CR1 terminals.

d. Coat both sides of the five TO-3 transistor mounting pads with heat conductive compound, Ampex 087-388. (Excessive amounts of heat conductive compound should be avoided.)

e. Mount the TO-3 transistors, complete with their mounting pads, into the heatsink. Tighten down mounting nuts.

f. Reconnect the leads to the five TO-3 transistors (fitted with slip-on connectors).

HEADDRIVER HOUSING REASSEMBLY AND REINSTALLATION

Refer to Figures 10-4, 10-5 and 10-6. To reassemble the headdriver housing assembly, proceed as follows:

a. Place the heatsink and transformer and capacitor assembly on a clean surface.

b. Take the righthand section of the housing and place it over the heatsink portion such that:

1. The upper lip of the righthand section fits between the top plate and the capacitor mounting bracket of the capacitor mounting area.

2. The connector of the righthand section fits over P1 of the A1 regulator board (attached to heatsink).

3. The lefthand side of the lower plate of the righthand section of the headdriver housing fits over the bottom edge of the heatsink.

c. Replace the 13 screws and two cable clamps previously taken out during the disassembly of the housing unit (see Figure 10-5). The two 6-32 screws holding the cable clamp are 0.5" in length; the balance are 0.38" in length.

d. Remount the headdriver housing to the transport baseplate with the four 10-32 hex socket head screws.

NOTE

This unit is extremely heavy and difficult to mount with one person. The assistance of a second individual is strongly recommended during this mounting procedure.

e. Reconnect cables P2 to J206, P3 to the preamplifier No. 2 housing and the ac cord (P1) to the 110V outlet within the transport.

f. Dress these cables and secure with the cable clamps.

g. Replace the headdriver pwa's and secure to the mother board with the 4-40 card retention screws. See Figure 10-4.

h. Replace the record signal interconnect cables as per their tagged positions and secure to the headdriver pwa's with the two each 4-40 connector retention screws.

i. Replace the head cables to the front connector (J2) of the headdriver pwa's in accordance with their previous tagging.

j. Secure the head connectors to the headdriver pwa's with the two 4-40 screws previously removed.

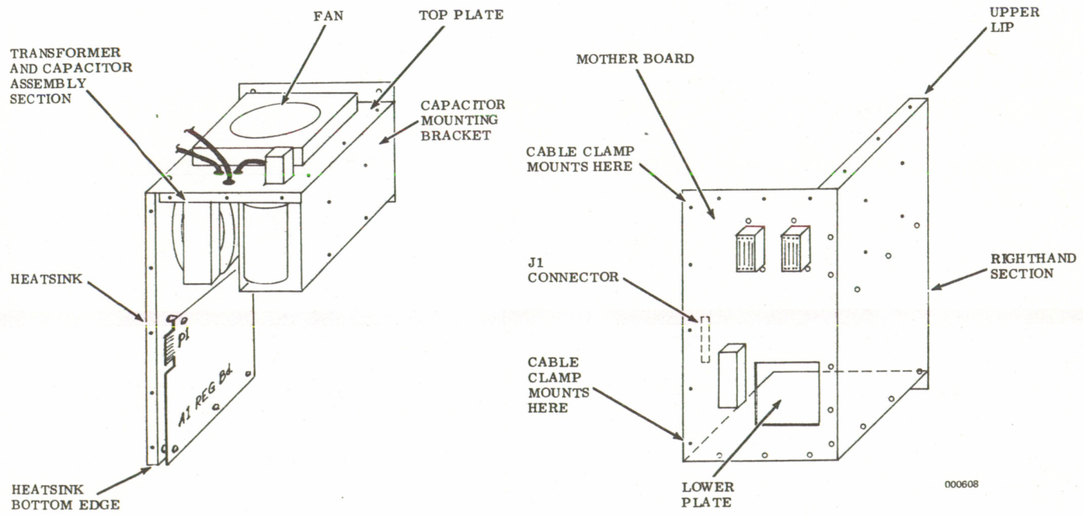

Figure 10-6. Headdriver Housing - Disassembly Details - Interior

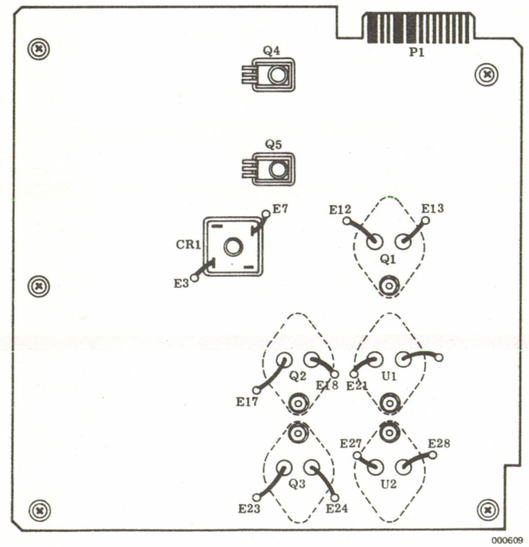

Figure 10-7. A1 Regulator PWA - With Components Involved with Removal/Replacement of PWA Outlined

REMOVAL AND REPLACEMENT OF PREAMPLIFIER NO. 1's

Extreme care should be taken whenever dealing with the head or preamplifier No. 1 area. Make sure that any tools that are used are not magnetized.

To remove and replace preamplifier No. 1's, proceed as follows:

a. Loosen the two cover retaining screws holding the preamplifier No. 1 housing cover and remove it. See Figure 10-8A.

b. Carefully pull the preamplifier harness assembly for the preamplifiers to be removed out of the preamplifier No. 1 housing. (The preamplifier No. 1's associated with the connectors should come with them. If they do not, use extreme care in removing them from the housing.) See Figures 10-8B and 10-8D.

c. Install the replacement preamplifier No. 1(s) into the preamplifier harness assembly connector (8 pins into the harness connector). See Figure 10-8C.

d. Insert the preamplifiers and their associated harness assembly into the preamplifier No. 1 housing guides. (The preamplifier No. 1's and their associated harness assembly should be considered as a single unit. As such, the whole unit should be pushed into the preamplifier No. 1 housing by light pressure on both ends of the preamplifier harness assembly. Do not use excessive force. If resistance is met while plugging the preamplifier No. 1's into the connectors of the preamplifier No. 1 housing, remove the preamplifier No. 1's and check to see if any of the pins are bent. If so, straighten them and re-insert the preamplifiers into the housing.) See Figure 10-8B.

e. Replace the preamplifier No. 1 housing cover plate.

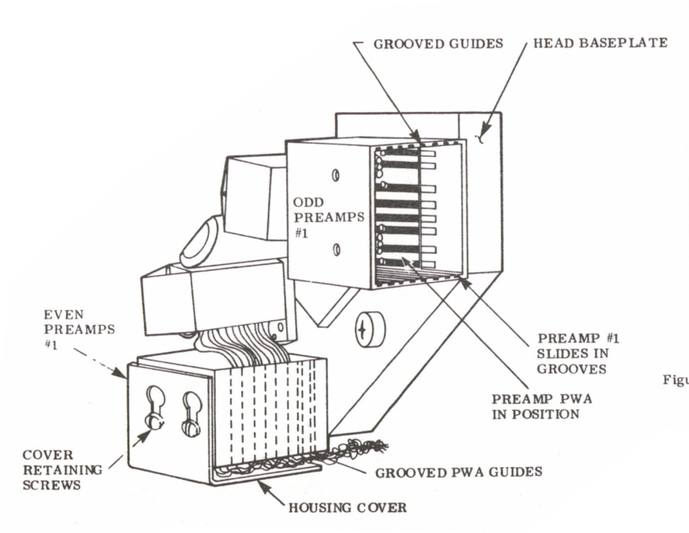

Figure 10-8A. Head ands Preamplifier #1 Housings

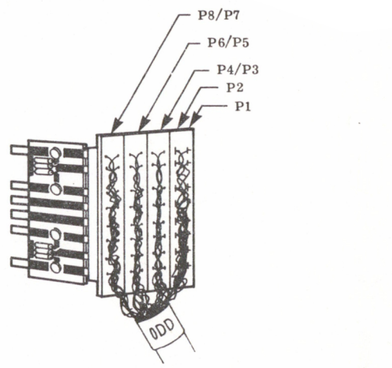

Figure 10-8B. Interconnect Boards and Harness Assembly with a Preamplifier #1 Pwa Installed

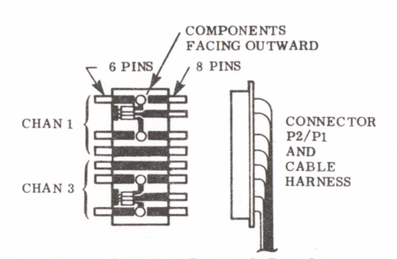

Figure 10-8C. Front View Preamp #1 Pwa, Interconnect Board, and Connectors

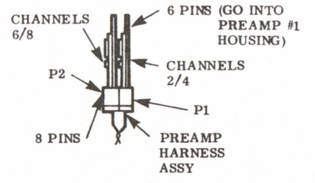

Figure 10-8D. Top View - Showing Two Preamp #1's Installed in Interconnect Board

000592A

Figure 10-8. Preamplifier No. 1 Housing and Preamplifier No. 1 PWA's Insertion Detail

REMOVAL AND REPLACEMENT OF PREAMPLIFIER NO. 2

In order to remove the preamplifier No. 2 pwa's from their housings, it will be necessary to remove the cover plate from the housing. When this is done, all of the preamplifier housing cables, which are individually attached to the housing cover by two 4-40 screws, will come with it. If, however, a single connector is to be removed, it is only necessary to remove the two screws which secure the connector to the preamplifier cover plate and pull the cable away from the associated preamplifier pwa.

To remove a preamplifier No. 2 pwa, proceed as follows:

a. Remove the two 4-40 cross recessed screws which hold the preamplifier housing cover plate to the housing.

b. Pull the cover with its attached preamplifier No. 2 cables away from the housing. (This should disconnect the connectors from the preamplifier pwa's. The preamplifier should be left in their guides within the housing assembly).

c. Pull out the required preamplifier pwa from the housing.

To replace the preamplifier No. 2 pwa reverse the procedures above.

NOTE

Before more than one cable connector is removed from the preamplifier No. 2 housing cover plate, it is recommended that they be tagged for ease of location when reinstalled.

SECTION 11
SPECIAL TOOLS AND TEST EQUIPMENT

SECTION 11

TEST EQUIPMENT AND SPECIAL TOOLS

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SECTION 11
TEST EQUIPMENT AND SPECIAL TOOLS

Test equipment, extender cards, and special tools required for maintenance of the FR3010 signal electronics system are listed in the tables below. The specific instruments cited in the tables are examples only. Any other instrument of equivalent capability is equally suitable.

Test equipment, extender cards, and special tools required for maintenance of the FR3000 transport are listed in Section 12 of the FR3000 Transport Maintenance Manual, Ampex 1802854.

Table 11-1. Test Equipment

Item	Type	Characteristics
Oscilloscope	Tektronics Model 465 or equivalent	Time base and reading accuracy should be sufficient to avoid degrading the measurement of the equipment performance.
Digital Voltmeter	Fluke 8000A or equivalent	Accuracy within 0.01%
Sine-wave Oscillator	Hewlett Packard 651A or equivalent	Noise, total distortion and spurious components to be below 0.25% for frequency range under test.
VTVM	Hewlett Packard 400D, H or L or equivalent	Accuracy within ±5% fs from 10 Hz to 4 MHz, average or true rms reading.
Wave Analyzer	Hewlett Packard 312A or Wandel and Goltermann TFPM43 or equivalent	Calibrated to an accuracy of 0.5 dB. Dynamic range of at least 50 dB.
Bandpass Filter	Kronhite 3103-4 or equivalent	Adjustable from 50 Hz to 2 MHz. Down no more than 3 dB at bandedge frequency. 18 dB per octave rolloff.
Electronic Counter	Hewlett Packard 5221B or equivalent	Range dc to 10 MHz
DC Voltage Source	Hewlett Packard 6113A or equivalent	±1.414V or regulated adjustable source of dc.
Load	---	75Ω non-inductive ±10% 1/2W.

Table 11-2. Extender Cards

Ampex Part No.	Use
1801658-01	Electronics Bay (Signal electronics pwa's)
1802849-01	Preamplifier No. 2
1802850-01	Headdriver
1802851-01	Extender cable for headdriver and extender card

Table 11-3. Tools or Material

Ampex Part No.	Type	Description
050-104	---	Head Cleaner
1815050-01	Ampex HD-16	Head Degausser
---	Tuning Tool	Non-metallic, 1/16 inch blade

SECTION 2
SYSTEM INSTALLATION

UNPACKING REQUIREMENTS

Ampex recorder/reproducers are prepared for shipment using various packing and packaging methods. The method selected for a given shipment depends on the mode of transportation, destination and contractual requirements.

WARNING

RACK-MOUNTED RECORDER/REPRODUCERS WITH TAPE TRANSPORTS INSTALLED HIGH IN THE RACK ARE VERY TOP-HEAVY. TO PREVENT INJURY TO PERSONNEL, OR DAMAGE TO THE EQUIPMENT, EXERCISE EXTREME CARE DURING UNPACKING AND HANDLING. AVOID TIPPING RACKS, AND DO NOT EXTEND THE TRANSPORT OR OTHER ASSEMBLIES UNTIL THE RACK IS BOLTED DOWN OR SECURED TO AN APPROVED DOLLY.

Magnetic tape recorder/reproducers are precision instruments, and adequate care must be employed during unpacking and handling to ensure proper operation of the equipment and to prevent equipment damage.

After unpacking make sure that all protective padding, blocks and tie downs used inside the equipment rack for shipment are removed. Inspect the equipment carefully for shipping damage, and if any is found, notify the shipping carrier and the local Ampex representative.

SITING

The FR3000 series magnetic tape recorder/reproducers can be installed in any location that provides a surface that is level, firm, free of vibration, and where ambient temperature and humidity fluctuations are kept as small as possible. In addition the environmental atmosphere should not contain corrosive fumes such as those found near storage batteries. Further the magnetic tape recorder/reproducers and magnetic tape should not be located in areas containing strong magnetic fields. These can cause deterioration or erasure of data (particularly high frequencies) on magnetic tape, and magnetization of the head assemblies and tape guides on the tape recorder itself.

For maintenance and operating purposes it is necessary that a minimum clear aisle space of 3 feet in front and 3 feet in back of the equipment is provided. See Figure 2-1 for the rack cabinet dimensions. A free flow of air through the rack must be maintained to prevent components from overheating.

The distribution of the weight of the units of the recorder/reproducer in the rack cabinet permits the operator to open an electronic tray or swing the tape transport out from the cabinet when the equipment is on a rack dolly. However, note the warning that follows:

WARNING

TO PREVENT INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT, NEVER EXTEND ALL BAYS, TAPE TRANSPORT, AND POWER AND SERVO UNIT AT THE SAME TIME UNLESS THE RACK CABINET IS BOLTED TO THE FLOOR.

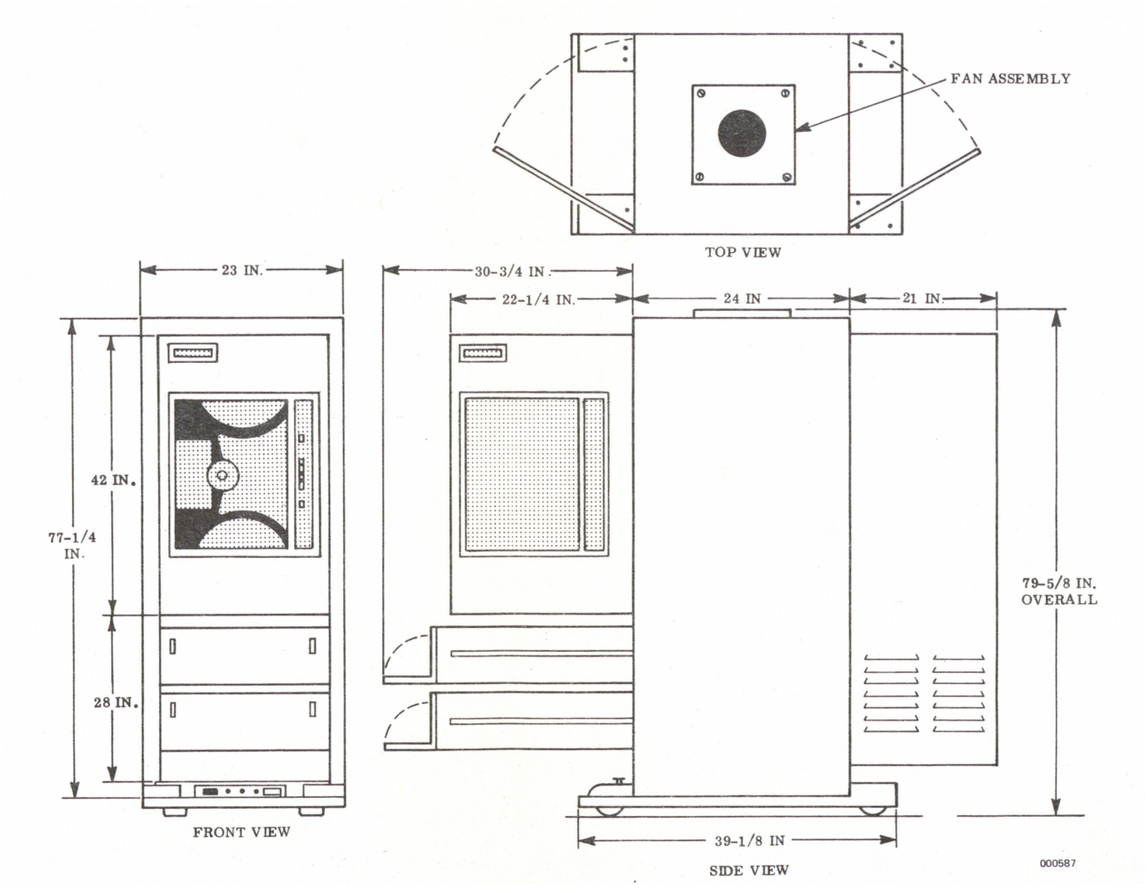

Figure 2-1. Rack Cabinet Dimensions

CABLE CONNECTIONS

SYSTEM CONNECTIONS

System cabling within the rack cabinet is usually installed at the factory. Should it become necessary to disconnect or remove any cables, cabling connections are shown in Figures 2-2 and 2-3A, B and C. Signal connections are made at the connectors at the rear of the signal electronics tray(s).

PRIME POWER CONNECTION

The primary power source, 105-125 volts, 47 - 63 Hz, is fed into a receptacle located on the rear panel at the bottom of the rack cabinet. A captive cable applies the primary voltage to the power panel, located on the recessed panel at the lower front of the rack cabinet.

A line filter assembly, Ampex 1802939 is available as an optional item for the FR3000 series recorder/reproducers. This filter assembly would normally be located on the rear insert panel at the bottom of the rack cabinet. An optional 220V to 110V step down transformer is also available (International Transfer Mounting Kit, Ampex 1802202).

SEQUENTIAL OPERATION CONNECTION

A sequential cable is available (Ampex 1802203) if sequential operation of two recorders is desired. The cable is connected between the SEQUENTIAL receptacles, J3, on the inner test panels, and the sequential switches (S6) are set to ON.

REMOTE CONTROL OPERATION CONNECTION

Operation of the FR3000 series recorder/reproducers from a remote location requires the use of remote control cable, Ampex 1802204. Connection for remote operation is made at the REMOTE receptacle, J7, on the inner test panel.

CONTROL TRACK OPERATION CONNECTION

A control track signal may be recorded and reproduced on any channel of the FR3000 series recorder/reproducers. To record the control track signal onto the tape, install pwa P107 (Ampex part number 1802905) in the power and servo unit, connect a jumper cable Ampex part number 26040-06 between CONTROL TRACK OUTPUT J22, on the inner test panel of the power and servo unit, and the record input bnc of the channel to be used on the rear of the appropriate electronics tray. (See Figures 2-2 and 2-3A, B and C.

To use this control track signal to control the servo, connect a jumper cable Ampex part number 26040-06 from CONTROL TRACK IN, J23, on the inner test panel to the channel output connector of the selected channel on the reproduce electronics tray. A jumper card (Ampex part number 1802477) must be utilized in place of a reproduce amplifier pwa when control track operation is desired.

EXTERNAL FREQUENCY STANDARD CONNECTION

If the operator desires, an external frequency standard may be substituted for the normal capstan speed reference signal. The external frequency source is connected to EXT FREQ STD J24 on the inner test panel, and the switch adjacent to J24 is set at EXT.

SEARCH OPERATION

An appropriate cable and attachment instructions for use with a Systron Donner Model SD8140 Time Code Generator is available (Ampex 1802273). The cable is connected to the SEARCH receptacle J6 of the power and servo unit. The schematic (Ampex 1248017), to interface the Time Code Generator with the FR3010 recorder/reproducer is also available.

ES-200 BUFFER CARD PWA

To assure proper operation of the FR3010 recorder/reproducers with the ES-200 Electronics, a buffer card pwa must be installed in the power supply section of the ES-200 electronics tray. The buffer card pwa, Ampex 1801914, is installed in the slot at the extreme left rear of each electronics tray.

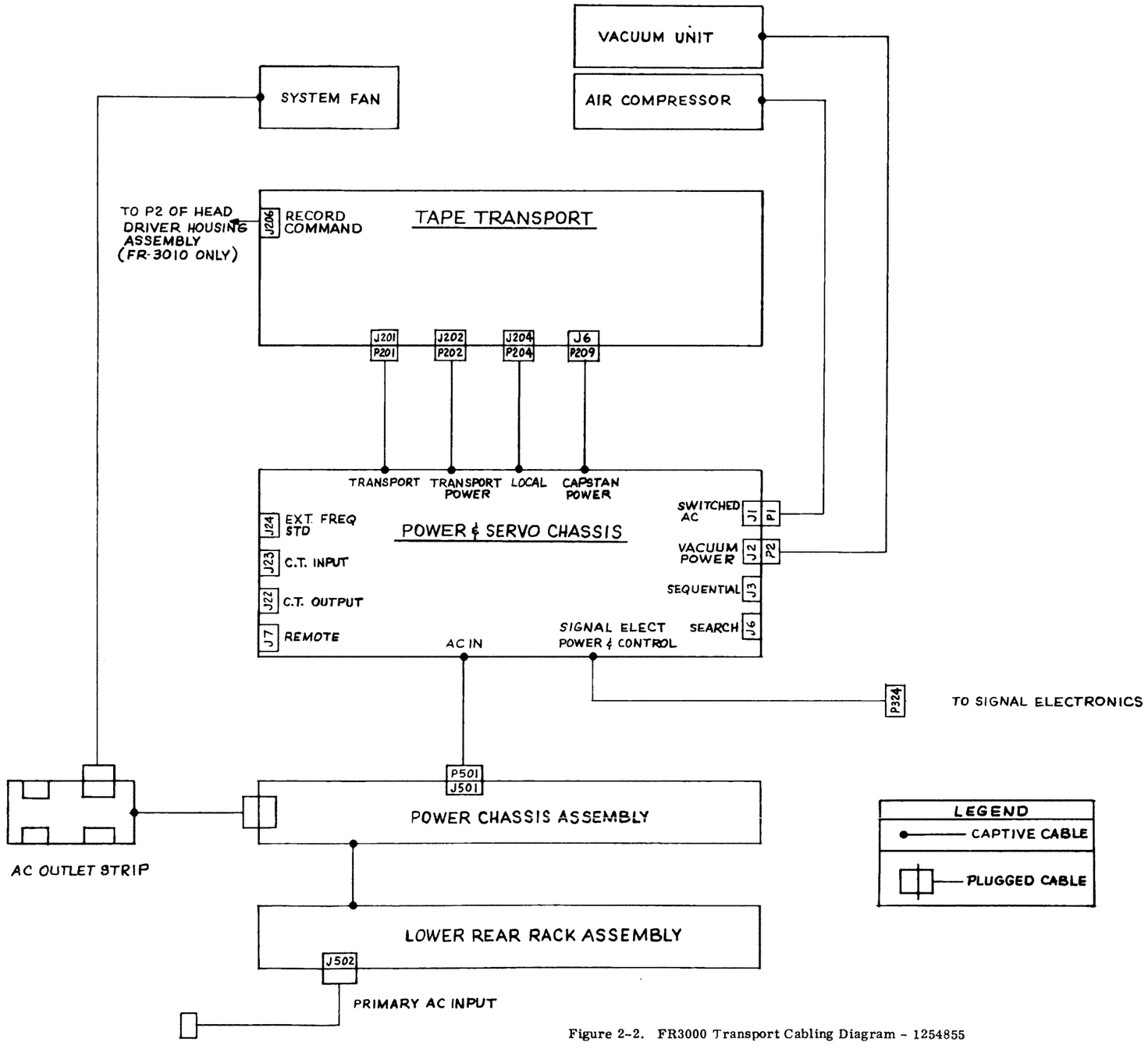

Figure 2-2. FR3000 Transport Cabling Diagram - 1254855

SECTION 7
PERFORMANCE CHECKS

GENERAL

Section 7, Performance Checks, contains information on the system performance. These will be broken down into:

a. Those checks concerned with the tape motion and tape transport preformance, Section 7.

b. Direct record/reproduce systems, Section 7A.

c. FM record/reproduce systems, Section 7B.

If the above checks indicate there are out-of-tolerance operating conditions then refer to the following sections/manuals for corrective maintenance procedures:

a. For FR3000 Tape Transport assemblies, see sections 9 through 11 of the FR3000 Tape Transport Maintenance Manual, Ampex part number 1802854.

b. For FR3010 Signal Electronics assemblies, see sections 8 through 10 of this manual, Ampex part number 1802852.

TAPE TRANSPORT CHECKS

TOOLS OR TEST EQUIPMENT REQUIRED

Oscilloscope.
Digital Voltmeter.

TRANSPORT CONFIDENCE CHECK

To verify that the tape transport is operating properly, the following procedure should be performed approximately once a month, and before any important data-recording operations. It should be followed by performance of the TEST SELECTOR switch check which follows.

To make a confidence check of the ac power, control logic, the servo systems, and the speed selection functions of the tape transport, proceed as follows:

a. Set main circuit breaker CB501 to ON. See that ac power indicator DS501 next to it lights.

b. Load a reel of tape onto the transport.

c. Press the POWER pushbutton switch on the control unit to turn power on. See that the POWER pushbutton lamp lights. When the vacuum blower provides adequate vacuum in the vacuum chamber the STOP READY pushbutton lights.

d. Check that the air compressor is providing adequate pressure to the air guides (2.5 psi on the compressor assembly gage).

e. Check that the vacuum level is correct, as read on the vacuum housing assembly gage. Refer to Table 7-1 for correct vacuum levels.

NOTE

For convenience and correctness in checking the vacuum, it is recommended that the column in the table giving the vacuum value(s) chosen for your machine be marked. (The table makes provision for such marking).

f. Initiate the forward mode at a tape speed of 1-7/8 ips.

g. Observe that the SYNC indicator lights.

h. With one hand, grasp one of the reels on the tape transport and stop it from turning. Observe that the capstan stops rotating and the SYNC indicator goes out.

i. Release the reel. If the reel was held for more than 2 seconds, the run command is lost and the STOP pushbutton must be pressed before the run command can be generated again. Therefore, if the capstan does not pull tape when the reel is released, press the STOP pushbutton, then press the FWD pushbutton. The tape should now move forward again.

j. Select 30 ips tape speed and observe that the capstan and reels accelerate smoothly to the new tape speed. Stop the transport.

k. Perform this same check in the reverse mode also.

Table 7-1. Recommended Vacuum Settings for High Speed Range

Tape Speed (ips)	VACUUM (Inches of Water)		
	1 Speed	2 or 3 Speed Nominal	6 Speed Nominal
1-7/8	11	11	11-1/2
3-3/4	11-1/2		
7-1/2	12	12	
15	13		
30	13-1/2	14	
60	14		
120	15-1/2	15-1/2	15-1/2
MARK (X or ✓) COLUMN TO BE USED			

TEST SELECTOR SWITCH CHECK

The TEST SELECTOR switch (S1 of the power and servo chassis) is located on the power and servo chassis test panel. It provides a means of checking various voltages and signals in the tape transport. It is used both for preventive maintenance and troubleshooting. To use the TEST SELECTOR switch for preventive maintenance, proceed as follows, using a digital voltmeter (1%) and an oscilloscope. Perform the procedure approximately once a month, and before any important data-recording operation, in conjunction with the above confidence check.

a. Connect an oscilloscope to the TEST SELECTOR bnc connector, J21, on the inner test panel.

b. Install and thread a reel of degaussed tape on the tape transport.

c. Ascertain the equipment is connected to 115V ac (230V ac for International versions) and that the ac power on indicator lamp, on the power panel, is lit.

d. Press the POWER pushbutton on the control unit to turn the tape transport power on. The slack in the tape should be drawn into the vacuum chambers. When the required pressure is established, the parking brakes release should be audible to the operator and the STOP/READY lamp should light.

e. Turn the TEST SELECTOR switch to +12V and measure the voltage. It should be +12(±0.5)V.

f. Turn the TEST SELECTOR switch to -12V position and measure the voltage. It should be -12(±0.2)V.

g. Turn the TEST SELECTOR switch to +5V position and measure the voltage. It should be +5(±0.5)V.

h. Turn the TEST SELECTOR switch to the +14V TAKE UP REELS position and measure the voltage. It should be +14(±2.0)V.

TAPE MOTION AND TAPE TRANSPORT (CONT)

i. Turn the TEST SELECTOR switch to the -16V TAKE UP REELS position and measure the voltage. It should be -16(±2.0)V.

j. Turn the TEST SELECTOR switch to the +28V CAPST position and measure the voltage. It should be +28 (±3.0)V.

k. Turn the TEST SELECTOR switch to the +28 SOLENOID position and measure the voltage. It should be +28(±3.0)V.

l. Turn the TEST SELECTOR switch to the -12V AIR SW position and measure the voltage. It should be -12(±2.0)V.

m. Turn the TEST SELECTOR switch to the TACH OUT position. With the tape transport in the standby condition (STOP/READY lamp lit), observe the oscilloscope display while moving the capstan puck by hand. A square wave should be displayed while the puck is in motion.

n. Turn the TEST SELECTOR switch to the -16V CAPST position and measure the voltage. It should be -16(±2.0)V.

o. Turn the TEST SELECTOR switch to the +14V SUPPLY REEL position and measure the voltage. It should be +14(±2.0)V.

p. Turn the TEST SELECTOR switch to -16V SUPPLY REEL position and measure the voltage. It should be -16(±2.0)V.

q. Turn the TEST SELECTOR switch to the PILOT SPLY position and measure the voltage. It should be +30(±2.0)V when POWER pushbutton is in the off position and +24(±2.0)V when POWER pushbutton is in the on position.

r. Turn the TEST SELECTOR switch to the RUN CMD position, press the forward pushbutton on at control panel, and measure the voltage. It should be +10(±1.0)V.

s. Turn the TEST SELECTOR switch to the OFF position. If all checks have been satisfactory, the equipment is ready for recording or reproducing. If the checks are not satisfactory, use normal troubleshooting techniques and alignment procedures to be found in the FR3000 Tape Transport Maintenance Manual, Ampex 1802854, Sections 9 and 10.

OPERATING MODE AND TAPE TRACKING CHECK

The operating mode and tape tracking check consists of observing operating conditions of the tape transport while moving tape. Perform the check as follows:

a. Load tape for normal operation and turn on system power.

b. Operate the tape transport in all modes, at all speeds and in both directions. Verify that the tape transport responds correctly to all of the mode commands and tape speed changes. If maintenance or adjustment is required, refer to the FR3000 Tape Transport Maintenance Manual, Ampex 1802854, Sections 8 through 12.

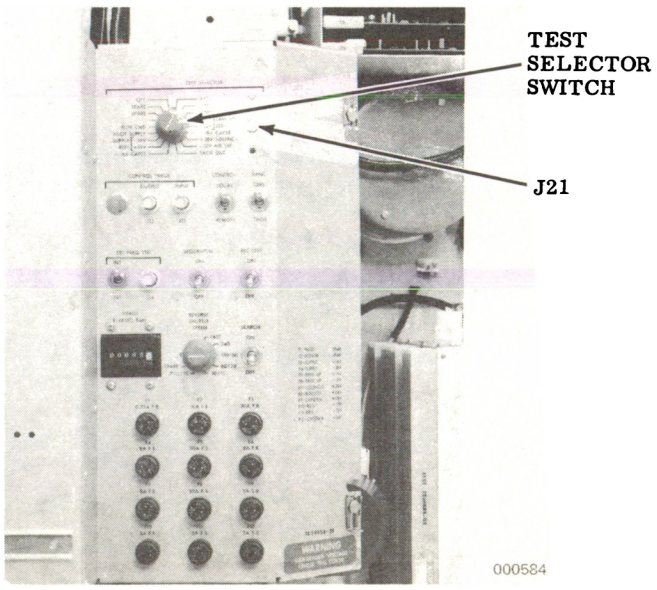

Figure 7-1. FR-3000 Transport Inner Test Panel

SECTION 8A DIRECT ADJUSTMENT PROCEDURES

GENERAL

DEFINITIONS - DIRECT

OPERATING INPUT LEVEL. Any data input level to the record amplifier, which falls between the minimum and maximum levels listed on the specification sheet, shall be known as the OPERATING INPUT LEVEL.

STANDARD RECORD LEVEL. The Record Level control is adjusted with a given input signal to produce a signal at the output of the reproduce amplifier which contains 1% third order harmonic distortion. This input signal shall be known as the STANDARD RECORD LEVEL signal. (This is similar to "Normal Record Level" as defined in IRIG 106-73.)

STANDARD OUTPUT LEVEL. The Reproduce Output Level control is normally adjusted to produce an output signal amplitude of 1 volt rms, as measured across the proper terminating impedance, when reproducing a STANDARD RECORD LEVEL signal. This signal shall be known as the STANDARD OUTPUT LEVEL signal. (Values other than 1 volt rms may be used, but degradation in signal-to-noise or distortion may result.)

OPERATING INPUT LEVEL UNKNOWN. Equipment is normally adjusted at the factory utilizing 1 volt rms for the STANDARD RECORD LEVEL. On site alignment may be made with a test signal generator producing either the sites' preferred STANDARD RECORD LEVEL or the factory STANDARD RECORD LEVEL.

OPTIONAL RECORD LEVEL MONITORING SYSTEM

An optional record level monitoring system, comprising a series of level meters or oscilloscopes, one for each channel, is available for correct adjustment of the electronics to different levels of data signals. After calibration of the monitors at the 1% third harmonic distortion level, this monitoring provision allows the record amplifier to be adjusted for correctly recording signals of various levels by means of the channel gain control located on the front of the appropriate record amplifier module. Detailed information and schematics of the electronic assemblies are included in the FR3010 Signal Electronics manual 1802855.

INTERCHANGEABLE PWA'S

Interchangeable modular printed circuit cards are used throughout the FR3010 Signal Electronics system. Interchange of these modules should not be made after system alignment unless the channels affected by the interchange are realigned.

ADJUSTMENTS

PREADJUSTMENT FUNCTIONS

Perform the following preadjustment functions:

a. Place the jumpers on the direct record and reproduce amplifier pwa's in the following configuration:

   1. Set record jumpers to match desired input impedance and input level range as per Figure 8A-1.

   2. Reproduce E1-E2, selects the correct bias trap. Refer to Figure 8A-2.

   3. Reproduce E5-E6, selects gain for wideband operation.

   4. Reproduce E13-E14 and E9-E10, inserts 400 Hz high pass filter.

b. Set R27 REC LEVEL, on the record amplifier, at midrange. (See Figures 8A-3 and 8A-5.)

c. Set INPUT LEVEL R4 and GAIN ADJ R48, on the reproduce amplifier, at midrange. (See Figures 8A-3 and 8A-6.)

d. Terminate the reproduce amplifier in 75Ω.

e. Using a convenient input signal reference level perform the following adjustments in the order listed:

   1. Bias - followed by

   2. Record level and second harmonic level - followed by

   3. Reproduce head azimuth - followed by

   4. Reproduce level - followed by

   5. Equalizer adjustments.

BIAS LEVEL ADJUSTMENT

To adjust the bias level, proceed as follows:

a. Set up the test equipment as shown in Figure 8A-4 with the filter disconnected (jumpered).

b. Connect the oscillator to the channel 1 input jack at the rear of the signal electronics tray.

c. Set the oscillator to the upper bandedge at the standard record level (see Tables 8A-1 and 8A-2).

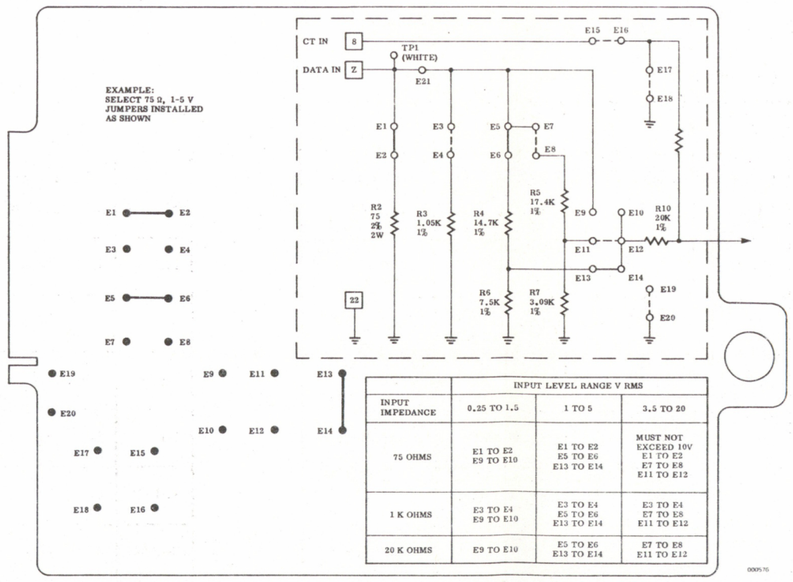

Figure 8A-1. Direct Record Amplifier Jumpering

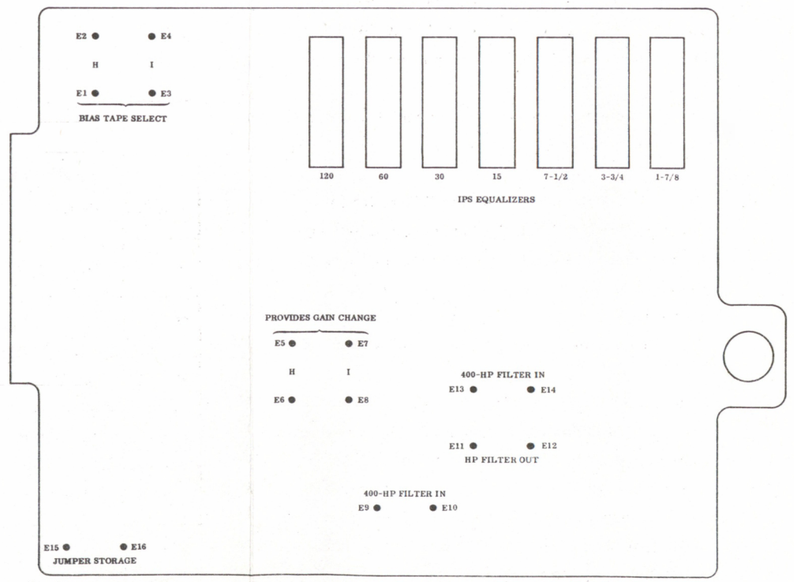

Figure 8A-2. Direct Reproduce Amplifier Jumpering

d. Press the POWER pushbutton to turn power on.

e. Switch to the tape speed being checked and initiate the record forward mode.

f. Adjust channel 1 BIAS control for maximum output. Continue to increase the setting (cw) until the output drops 2 dB for 2.0 wideband direct and 1 dB for 1.5 wideband direct. See Figures 8A-7 and 8A-8.

g. Press the STOP pushbutton.

h. Repeat steps b through g for the remaining channels using the appropriate adjustments.

RECORD LEVEL AND SECOND HARMONIC LEVEL ADJUSTMENTS

To adjust the record level, proceed as follows:

a. Connect the oscillator to the channel 1 input jack at the rear of the signal electronics tray.

b. Set oscillator to the record level set frequency for the tape speed being checked at the standard record level (see Tables 8A-1 and 8A-2).

c. Switch to the tape speed being checked and initiate the forward record mode.

d. Set REC LEVEL potentiometer R27 to its mid-scale position. Check the reproduce output signcal for second harmonic distortion and adjust the appropriate second harmonic ($2f_o$) control on the headdriver for minimum second harmonic distortion. (See Figures 8A-5, 8A-7 and 8A-8).

e. Check third harmonic distortion and adjust R27 for 1% third harmonic distortion. The wave analyzer, tuned to the third harmonic of the reproduced signal, should read -40 dB relative to the fundamental (± correction for any gain difference between the fundamental and third harmonic component).

f. Remeasure second harmonic distortion. It should now be at least -46 dB from the reference level. Readjust $2f_o$ control slightly to minimize second order harmonic distortion, if necessary.

NOTE

If the $2f_o$ control was more than slightly readjusted, check the bias level and 3rd order harmonic distortion again.

g. Press the STOP pushbutton.

h. Repeat steps a through g for the remaining channels using the appropriate REC LEVEL and $2f_o$ controls.

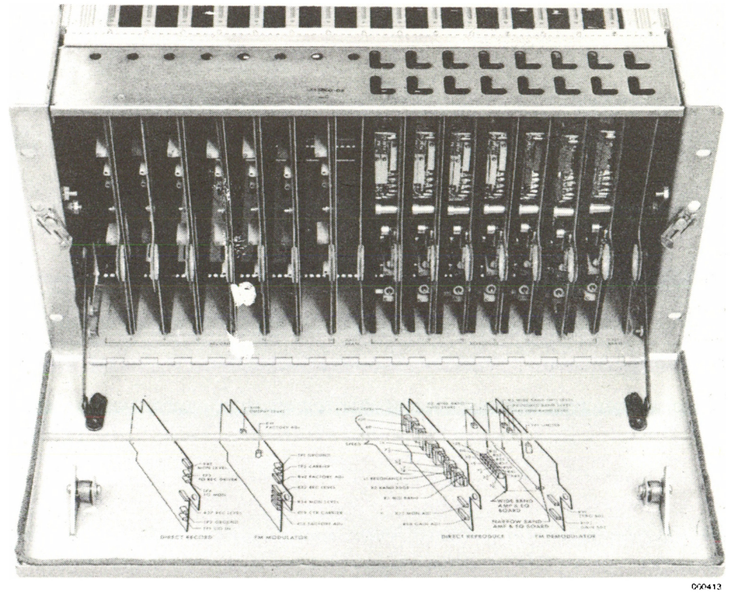

Figure 8A-3. Signal Electronics Tray - Showing Signal Electronics Adjustment Callouts

Table 8A-1. 2.0 Wideband Setup Frequencies

SPEED	REPRO REF FREQ	PEAK FREQ	LOW BAND-EDGE	UPPER BAND-EDGE	RECORD LEVEL SET FREQ	2/3 UPPER BAND-EDGE
120	200 kHz	300 kHz	400 Hz	2 MHz	200 kHz	1.33 MHz
60	100 kHz	150 kHz	400 Hz	1 MHz	100 kHz	666 kHz
30	50 kHz	80 kHz	400 Hz	500 kHz	50 kHz	333 kHz
15	25 kHz	50 kHz	400 Hz	250 kHz	25.0 kHz	166 kHz
7-1/2	12.5 kHz	22 kHz	400 Hz	125 kHz	12.5 kHz	83.2 kHz
3-3/4	6.25 kHz	10 kHz	400 Hz	62.5 kHz	6.25 kHz	41.6 kHz
1-7/8	3.125 kHz	5 kHz	400 Hz	31.25 kHz	3.125 kHz	20.8 kHz

Table 8A-2. 1.5 Wideband Setup Frequencies

SPEED	REPRO REF FREQUENCY	PEAK FREQUENCY	LOW BANDEDGE	UPPER BANDEDGE	RECORD LEVEL SET FREQUENCY
120	150 kHz	250 kHz	400 Hz	1.5 MHz	150 kHz
60	75 kHz	150 kHz	400 Hz	750 kHz	75 kHz
30	37.5 kHz	75 kHz	400 Hz	375 kHz	37.5 kHz
15	18.7 kHz	36 kHz	400 Hz	187 kHz	18.7 kHz
7-1/2	9.3 kHz	20 kHz	400 Hz	93 kHz	9.3 kHz
3-3/4	4.6 kHz	10 kHz	400 Hz	46 kHz	4.6 kHz
1-7/8	2.3 kHz	5 kHz	400 Hz	23 kHz	2.3 kHz

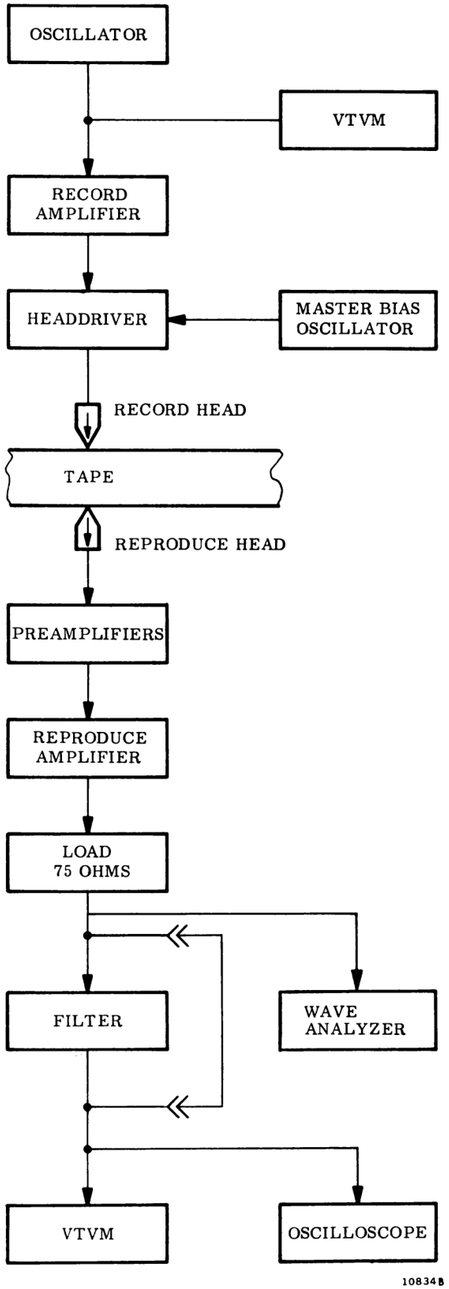

Figure 8A-4. Wideband Direct Signal Electronics Test Setup

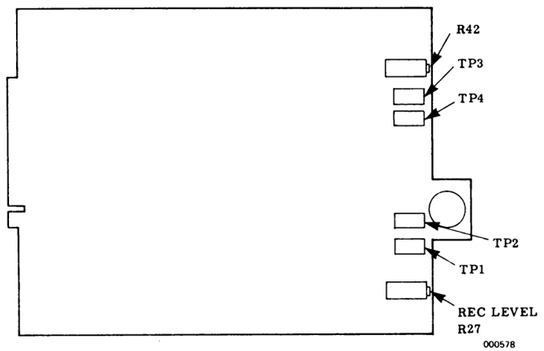

Figure 8A-5. Direct Record Amplifier Adjustments

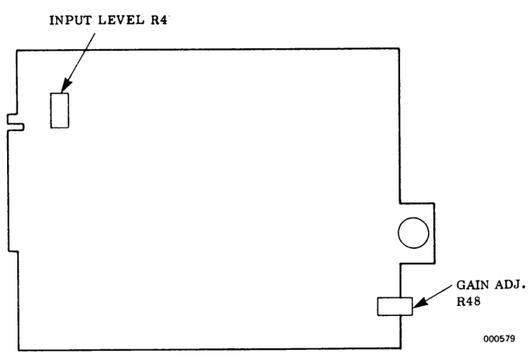

Figure 8A-6. Direct Reproduce Amplifier Adjustments

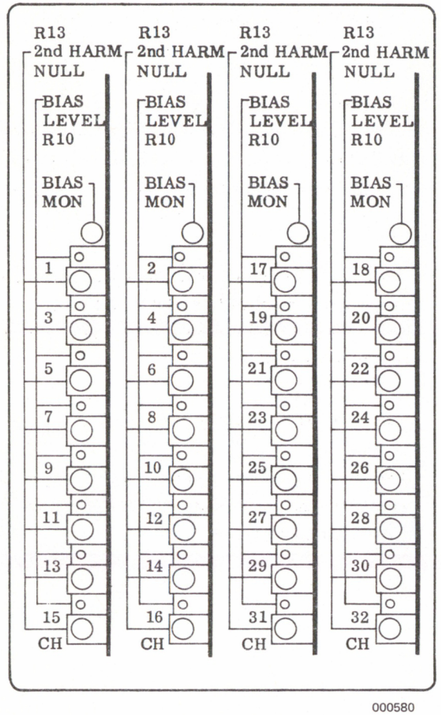

Figure 8A-7. Headdriver Controls

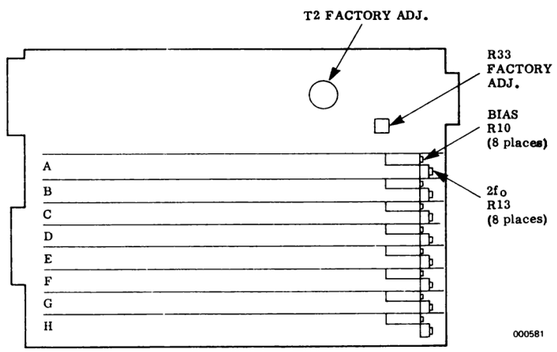

Figure 8A-8. Headdriver Assembly Adjustments

HEADDRIVER-BIAS AMPLIFIER SECTION-FACTORY ADJUSTMENTS

These adjustments are normally considered factory adjustments. They should not require field adjustment unless components have been replaced in the headdriver pwa.

a. Primary output transformer T2. This transformer is part of the output stage of the bias amplifier. It forms a resonant circuit tuned to 7.7 MHz. The inductance of transformer T2 is adjusted by a tuning slug for minimum dc current drain from the +18V dc power supply. It is a one time only factory adjustment.

b. OUTPUT ADJUSTMENT R33. R33 is in the agc circuit of the bias amplifier section of the headdriver pwa. This amplifier section provides sufficient bias current for up to eight tracks of record signal amplifiers. The OUTPUT ADJ potentiometer R33 determines the amount of agc voltage and thus the exact bias amplifier output voltage. For 2.0 and 1.5 MHz systems R33 is adjusted so that a peak-to-peak voltage measured across TP7 and TP8 (gnd) is between 20-22V p-p. The exact amount being a factor of the particular headstacks in use. Unless the record heads are being changed, it is <u>not</u> recommended that R33 be touched. (An extender board and a non-metallic, blade screwdriver will be required for this adjustment.)

REPRODUCE HEAD AZIMUTH ADJUSTMENT

To adjust the reproduce head azimuth, proceed as follows:

a. Connect the oscillator to the channel 1 input jack at the rear of the signal electronics tray.

b. Set the oscillator to the upper bandedge at the tape speed being checked at the standard record level (see Tables 8A-1 and 8A-2).

c. Switch to the tape speed being checked and initiate the forward record mode.

d. Adjust the appropriate reproduce head azimuth screw for maximum output signal. See Figure 8A-9.

e. Repeat step d for the remaining channels and make a final adjustment of head azimuth as a compromise between output signals from the various channels.

f. Press the STOP pushbutton.

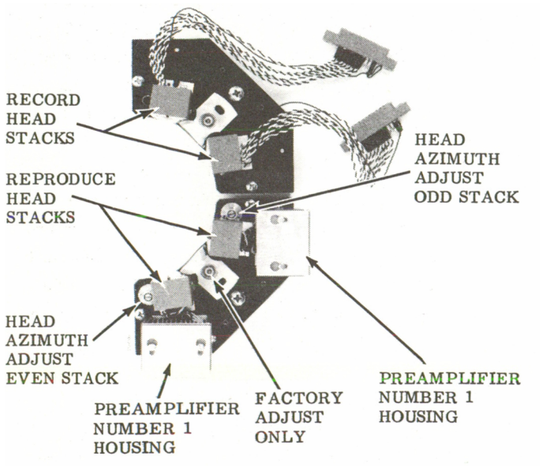

Figure 8A-9. FR3010 Record/Reproduce Heads - Showing Azimuth Adjustments

REPRODUCE LEVEL ADJUSTMENT

To adjust the reproduce level, proceed as follows:

a. Connect the oscillator to the channel 1 input jack at the rear of the signal electronics tray.

b. Set the oscillator to the peak frequency at the tape speed being checked at the standard record level (see Tables 8A-1 and 8A-2).

c. Switch to the tape speed being checked and initiate the forward record mode.

d. Turn GAIN ADJ control R48 cw to midrange position. Turn R4 until saturation or higher distortion of reproduce signal just starts (see Figure 8A-10) then back off R4 until signal is reduced 3 to 6 dB.

e. Set the oscillator to 0.02 of the upper bandedge frequency and adjust R48 OUTPUT LEVEL control so that the reproduce level is the standard record level - 1V rms.

f. Press the STOP pushbutton.

g. Repeat steps a through f for the remaining channels using the appropriate INPUT LEVEL and GAIN ADJ controls.

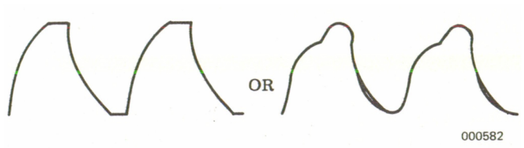

Figure 8A-10. Signal Saturating

EQUALIZER ADJUSTMENT

To adjust the equalizer, proceed as follows:

a. Connect the oscillator to the channel 1 input jack at the rear of the signal electronics tray.

b. Switch to the tape speed being checked and initiate the forward record mode.

c. Set the oscillator to the record level set frequency for the tape speed being checked at the standard record level and adjust peak level control R3 for the standard output level - 1V rms at the reproduce output. See Figure 8A-11.

d. For 1.5 wideband system proceed to step e. For 2.0 wideband systems proceed to step j.

e. Set the oscillator to the upper bandedge frequency at the standard record level.

f. Adjust upper bandedge resonance inductor L1 for maximum reproduce output.

g. Adjust bandedge level control R2, for a reproduce output that is -2 dB to -3 dB below the standard output level.

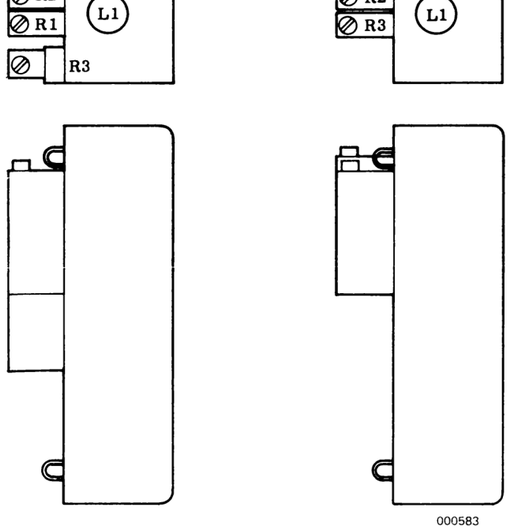

Figure 8A-11. Direct Equalizer Adjustments

h. Sweep the oscillator between the low bandedge frequency and the upper bandedge frequency. Response should be within ±3 dB from the reproduce reference frequency. Peaks or valleys in the response curve that exceed ±3 dB from the reproduce reference frequency may be attenuated by adjusting L1. If L1 is adjusted, R2 must be readjusted as in step g.

NOTE

Resonance control L1 should never be adjusted more than a few turns from the setting obtained in step f.

i. Press the STOP pushbutton. Proceed to step q.

j. Set the oscillator to 0.9 upper bandedge at tape speed being checked at the standard record level

k. Adjust L1 on the equalizer for maximum output.

l. Adjust R1 on the equalizer for the standard output level out of the reproduce amplifier.

m. Set the oscillator to upper bandedge and adjust R2 on the equalizer for a reproduce output of -2 dB below the standard output level.

n. Sweep the oscillator between the low bandedge and upper bandedge. If the response is not within ±3 dB from the reproduce reference frequency, a slight adjustment of L1 and R1 may be necessary. If L1 is readjusted, R2 must be readjusted as in step m above.

o. Further adjustment to aid response may be achieved with peak level control R3.

p. Press the STOP pushbutton.

q. Repeat steps b to p for all other tape speeds.

r. Repeat steps a to q for the remaining channels.